

Maintenance Manual

ShockLine™ Vector Network Analyzer

MS46522A

50 kHz to 4.5 GHz

50 kHz to 8.5 GHz



Anritsu

Safety Symbols

To prevent the risk of personal injury or loss related to equipment malfunction, Anritsu Company uses the following symbols to indicate safety-related information. For your own safety, please read the information carefully *before* operating the equipment.

Symbols Used in Manuals

Danger



This indicates a risk from a very dangerous condition or procedure that could result in serious injury or death and possible loss related to equipment malfunction. Follow all precautions and procedures to minimize this risk.

Warning



This indicates a risk from a hazardous condition or procedure that could result in light-to-severe injury or loss related to equipment malfunction. Follow all precautions and procedures to minimize this risk.

Caution



This indicates a risk from a hazardous procedure that could result in loss related to equipment malfunction. Follow all precautions and procedures to minimize this risk.

Safety Symbols Used on Equipment and in Manuals

The following safety symbols are used inside or on the equipment near operation locations to provide information about safety items and operation precautions. Ensure that you clearly understand the meanings of the symbols and take the necessary precautions *before* operating the equipment. Some or all of the following five symbols may or may not be used on all Anritsu equipment. In addition, there may be other labels attached to products that are not shown in the diagrams in this manual.



This indicates a prohibited operation. The prohibited operation is indicated symbolically in or near the barred circle.



This indicates a compulsory safety precaution. The required operation is indicated symbolically in or near the circle.



This indicates a warning or caution. The contents are indicated symbolically in or near the triangle.



This indicates a note. The contents are described in the box.



These indicate that the marked part should be recycled.

For Safety

Warning



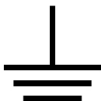
Always refer to the operation manual when working near locations at which the alert mark, shown on the left, is attached. If the operation, etc., is performed without heeding the advice in the operation manual, there is a risk of personal injury. In addition, the equipment performance may be reduced.

Moreover, this alert mark is sometimes used with other marks and descriptions indicating other dangers.

Warning



or



When supplying power to this equipment, connect the accessory 3-pin power cord to a 3-pin grounded power outlet. If a grounded 3-pin outlet is not available, use a conversion adapter and ground the green wire, or connect the frame ground on the rear panel of the equipment to ground. If power is supplied without grounding the equipment, there is a risk of receiving a severe or fatal electric shock.

Warning



This equipment can not be repaired by the operator. Do not attempt to remove the equipment covers or to disassemble internal components. Only qualified service technicians with a knowledge of electrical fire and shock hazards should service this equipment. There are high-voltage parts in this equipment presenting a risk of severe injury or fatal electric shock to untrained personnel. In addition, there is a risk of damage to precision components.

Caution



Electrostatic Discharge (ESD) can damage the highly sensitive circuits in the instrument. ESD is most likely to occur as test devices are being connected to, or disconnected from, the instrument's front and rear panel ports and connectors. You can protect the instrument and test devices by wearing a static-discharge wristband. Alternatively, you can ground yourself to discharge any static charge by touching the outer chassis of the grounded instrument before touching the instrument's front and rear panel ports and connectors. Avoid touching the test port center conductors unless you are properly grounded and have eliminated the possibility of static discharge.

Repair of damage that is found to be caused by electrostatic discharge is not covered under warranty.

Warning



This equipment is supplied with a rechargeable battery that could potentially leak hazardous compounds into the environment. These hazardous compounds present a risk of injury or loss due to exposure. Anritsu Company recommends removing the battery for long-term storage of the instrument and storing the battery in a leak-proof, plastic container. Follow the environmental storage requirements specified in the product data sheet.

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Chapter 1 — General Information

1-1 Introduction

This manual provides service and maintenance information for the Anritsu ShockLine MS46522A Vector Network Analyzer. The information includes product description, performance verification procedures, parts removal and replacement procedures, and troubleshooting information.

1-2 Description

The ShockLine MS46522A Vector Network Analyzer is an instrument system that contains a built-in source, test set, and analyzer. Designed for manufacturing application, the ShockLine MS46522A supports remote test programming through LAN communications. Test results can be displayed real time on an external video monitor.

Standard Accessories

Each instrument includes:

- User Documentation USB device: Includes ShockLine Application Software, Portable Document Format (PDF) files of the MS46522A Operation Manual, User Interface Reference Manual, Programming Manual, Calibration and Measurement Guide, and the Technical Data Sheet
- Power Cord

Available Options

The main system options are:

- MS46522A-001 – Rack Mount
- MS46522A-002 – Time Domain
- MS46522A-005 – Handler Interface
- MS46522A-004 – Frequency Option, 50 kHz to 4.5 GHz, type N(f) test ports
- MS46522A-010 – Frequency Option, 50 kHz to 8.5 GHz, type N(f) test ports

Identification Number

All Anritsu MS46522A instruments are assigned a seven-digit ID number (Serial Number), such as “1334203”. This number appears on a decal affixed to the rear panel.

When corresponding with Anritsu Customer Service, please use this identification number with reference to the specific instrument model number, installed options, and serial number. For example, a MS46522A, Option 2, Option 10, Serial Number 1234567.

1-3 Related Documents

Other documents are available for the MS46522A at the Anritsu web site at: www.anritsu.com

- ShockLine MS46522A Series VNA Technical Data Sheet – part number 11410-00750
- ShockLine MS465xxA VNA Operation Manual – part number 10410-00330
- ShockLine MS465xxA VNA Calibration and Measurement Guide – part number 10410-00331
- ShockLine MS465xxA VNA User Interface Reference Manual – part number 10410-00332
- ShockLine MS465xxA VNA Programming Manual – part number 10410-00333

1-4 Basic Maintenance

Maintain Operating System Integrity

The Microsoft Windows embedded operating system on the ShockLine MS46522A is configured for optimum performance when the instrument leaves the factory. To maintain the system's operating integrity, follow proper Windows shutdown procedures and DO NOT modify the operating system configuration, the firewall settings, the system registry, the solid state drive partitions, or the Anritsu user account.

Antivirus Protection, Best Practices

If the VNA is attached to a network, best practices recommend installing antivirus software. Anritsu recommends connecting the instrument only to a secure network.

The user assumes the responsibility to provide virus protection because this is not supplied with the instrument. Contact your network administrator for information about your network security and antivirus protection policies.

Note	Stability of the system is not guaranteed with all antivirus software.
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Windows OS Updates

Not all Microsoft updates are compatible with the ShockLine MS46522A VNA and, if installed, may affect the performance of the instrument.

Caution	Changing some of the default Windows settings may cause a loss of instrument control or undesired instrument behavior. Changing the Windows Regional and Language Options settings may cause unstable menu operation. These settings must be maintained as English (United States) as is set at the factory by default.
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Solid State Drive Data Backup

Anritsu recommends that you make a backup copy of your critical data stored on the VNA solid state drive as often as possible.

Note	Anritsu reserves the right to reformat or replace the VNAs solid state drive as part of the repair. In such incidence, all user data on the drive will be erased.
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Calibration/Certification

Test instruments are often put on a calibration cycle for performance verification in order to provide a quality check or assurance. The details of the performance verification procedures are included in [Chapter 2 — Performance Verification](#).

Repair Service

In the event that the MS46522A VNA requires repair, contact your local Anritsu Service Center. See [Section 1-5 “Anritsu Customer Service Centers”](#) for contact information. When contacting an Anritsu Service Center, please provide the following information:

- Your company name and address
- The model number and serial number of the instrument
- A detailed description of the problem

1-5 Anritsu Customer Service Centers

For the latest service and sales information in your area, please visit the following URL:

<http://www.anritsu.com/contact.asp>

Choose a country for regional contact information.

1-6 Recommended Test Equipment

The following test equipment is recommended for use in testing and maintaining the ShockLine MS46522A.

Table 1-1. Recommended Test Equipment

Equipment	Critical Specification	Recommended Manufacturer/Model	Use Codes ^a
Calibration Kit	Frequency: DC to 18 GHz Connector: N Type	Anritsu Model 3653A	P
Verification Kit	Connector: N Type	Anritsu Model 3663-2 (3663-1 is also supported)	P
Adapter	Frequency: DC to 18 GHz Connector: N(m) to K(m)	Anritsu Model 34NK50	P, A
Adapter	Frequency: DC to 18 GHz Connector: N(m) to K(f)	Anritsu Model 34NKF50	P, A
Fixed Attenuator	Frequency: DC to 8.5 GHz Attenuation: 10 dB	Aeroflex/Weinschel Model 44-10	A
Torque Wrench	3/4 in (0.75 in) Open End Wrench 12 lbf·in (1.35 N·m)	Anritsu Model 01-200	P
RF Coaxial Cable	Frequency: DC to 40 GHz Impedance: 50 ohm Connector: K(f) to K(m)	Anritsu Model 3670K50-2	P, A
Interface Cable	Ethernet: RJ48, cross-over, Cat.5E Ethernet: RJ48, Cat.5E	Anritsu Part Number 3-806-152 Anritsu Part Number 2000-1371-R	P
Personal Computer	Operating System: Windows 7 Interface: Ethernet (RJ-48), GPIB Software: National Instruments VISA version 4.4.1 or later	Any	P
System Verification Software	Medium: USB Flash Drive	Anritsu Part Number 2300-560-R	P
GPIB Adapter		National Instruments Model GPIB-USB-HS	A
GPIB Cable	Length: 2 m	Anritsu Part Number 2100-2-R	A
Frequency Counter	Frequency: 10 MHz to 20 GHz	Anritsu Model MF2412B or MF2412C with Option 3	A
Frequency Reference	Frequency: 10 MHz	Symmetricom Model RubiSource T&M	A
RF Coaxial Cable	Frequency: 10 MHz Impedance: 50 ohm Connector: BNC(m) to BNC(m)	Anritsu Part Number 2000-1627-R	A
Power Meter	Power Range: -70 to +20 dBm	Anritsu Model ML2438A	A
Power Sensor	Frequency: 100 kHz to 18 GHz Connector Type: N(m)	Anritsu Model SC7400	A

a. P= Performance Verification; A = Adjustment

1-7 Replaceable Parts and Assemblies

To ensure that the correct options are provided on the replacement assembly when ordering a VNA module assembly, all installed instrument options must be declared on the order. The installed options are listed on a label on the rear panel of the MS46522A. They can also be viewed in the ShockLine application About box dialog (Select: 9 Help | 1. About Anritsu). The table below summarizes the available replaceable parts and assemblies.

Table 1-2. Replaceable Parts and Assemblies

Part Number	Description
ND81174	VNA Module Assembly for MS46522A Instruments with Option 4
ND81175	VNA Module Assembly for MS46522A Instruments with Option 10
ND80983	CPU Assembly
ND80984	Solid State Drive with Operating System software and ShockLine Application
ND80997	Solid State Drive with Operating System software and ShockLine Application – For Revision 2 Instrument only
ND80985	Full Mini PCIe PCB Assembly
ND80994	Back Plane PCB Assembly
ND80995	IO Handler PCB Assembly – For Revision 2 Instrument only
ND80996	IO Handler PCB Assembly – For Revision 2 Instrument with Option 5 only
3-2000-1802	USB to Digital IO PCB Assembly – For Revision 2 Instrument with Option 5 only
ND80986	Fan Assembly, Right
ND80987	Fan Assembly, Left
ND80989	Fan Assembly, Rear
3-40-191	Power Supply Assembly
ND80990	19 V CPU Main Board Cable Assembly
ND80991	5 V Power Supply Cable Assembly
ND80992	12 V & 3.3 V Power Supply Cable Assembly
3-513-122	N female Test Port Adapter

Chapter 2 — Performance Verification

2-1 Introduction to Performance Verification

This chapter provides procedures to be used to verify the performance of the ShockLine MS46522A. There are many levels to the concept of VNA “verification” which ultimately is a comparison against expected behaviors.

On the explicit VNA hardware level are operational checkout items such as port power and noise levels. On the calibrated instrument level (which includes the VNA and the calibration kit or AutoCal automatic calibration module) are the residual specifications (corrected directivity, source match, load match, and tracking), which are measured using traceable airlines (absolute impedance standards).

The intermediate level looks at overall system behavior (VNA, calibration kit, cables, environment) in a traceable fashion through the use of a verification kit. While not intended for day-to-day use, the verification kit provides a periodic check of system behavior without going through the rigor needed for full residual analysis (which can usually be done less often).

While there are many ways of verifying VNA performance, sometimes simple procedures are desired. The use of a verification kit, available from Anritsu, is a simple method of verifying the measurement capabilities of the instrument by analyzing the measurement of artifacts that are traceable to national standards laboratories.

2-2 VNA Traceability and Uncertainty

Vector network analyzers (VNAs) are precision instruments for making high frequency and broadband measurements in devices, components, and instrumentations. The accuracy of these measurements is affirmed by demonstrated and adequate traceability of measurement standards. Metrological traceability, per International vocabulary of metrology, JCGM 200:2008, is property of a measurement result whereby the result can be related to a reference through a documented unbroken chain of calibrations, each contributing to the measurement uncertainty. For the accuracy of VNAs and quality assurance by users, two standard approaches were created to ensure sound metrology traceability. One is to construct tight uncertainty budget and specifications in three tiers from the ground up, and the other is to develop a calibration hierarchy for systematic verification. The three-tier process is depicted in the sections below.

First Tier of Uncertainty – The VNA Calibration

A traceable VNA itself requires proper calibration for several key quantities; for example frequency, power level, and high level noise via traceable standards to the SI units. Each contributing uncertainty was evaluated at the time of instrument calibration.

The inception of a precision VNA is accuracy-enhanced 50 ohm impedance, which is characterized in lieu of coaxial transmission lines all with proper propagation properties throughout the whole measurement systems including the device-under-test. A transmission line for VNAs is best represented by a coaxial airline, which was precisely selected and machined based on the electromagnetic properties of conductivity and skin depth, etc. Therefore, the dimensional measurement accuracy of the airline gives out the first tier of measurement uncertainty of impedance quantity.

Second Tier of Uncertainty – Systematic Measurement Errors

The second tier of uncertainty, corrected or residual uncertainty, is the result of the accuracy enhancement of VNA calibration to remove systematic errors. Systematic measurement errors are components of measurement error that in replicate measurements remains constant or values in a predictable manner. This accuracy enhancement is usually the function of calibration kits. The choice of calibration kits used dictates the level of uncertainties for the intended measurements or applications.

Third Tier of Uncertainty – Random Measurement Error

The third tier of uncertainty is random measurement error that in replicate measurements varies in an unpredictable manner. The examples are connector repeatability and cable stability, etc. Random measurement error equals measurement error minus systematic measurement error.

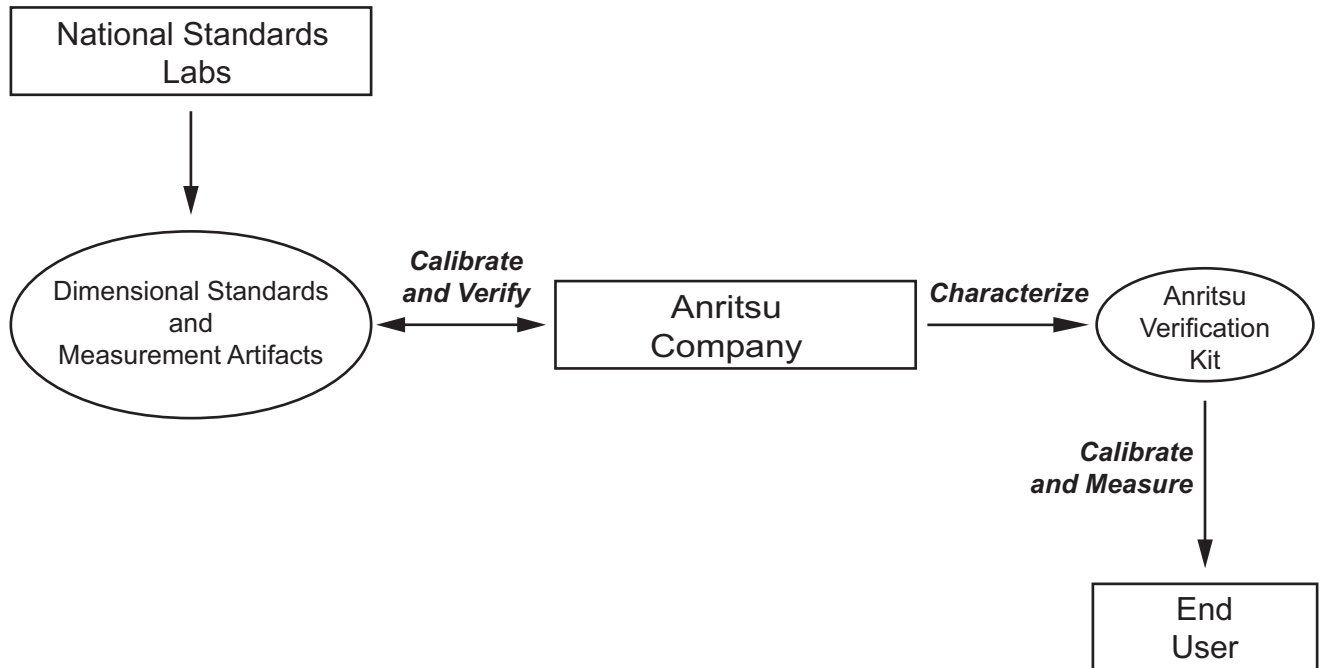
Standards and Verification

Most often, instrument end users demand system verifications in order to provide quality assurance. This is accomplished by utilizing a set of known or characterized devices; for example verification kits for comparison. It can also be done by using devices that are different from the calibration kit. The calibration hierarchy of verification uncertainty is built through unbroken chain comparisons with the national standards.

- Physical standards → airline dimensionality → impedance standard → residuals and port parameters
- Basic power standards → power sensors → power accuracy specifications
- Basic time standards → frequency reference source → frequency accuracy

2-3 Process for Creation and Use of a Verification Kit

This process is illustrated in [Figure 2-1](#) below. More information is available from the Anritsu metrology department.



The general process of the creation and use of a verification kit is shown here. A national standards laboratory helps validate the calibration through standards and measured artifacts. At Anritsu Company, these standards and artifacts are used to characterize the components of the verification kit that is sent to the user.

Figure 2-1. Process for Creation and Use of a Verification Kit

2-4 Electrostatic Discharge Prevention

All electronic devices, components, and instruments can be damaged by electrostatic discharge. Thus, it is important to take preventative measures to protect the instrument from damage caused by electrostatic discharge. Prior to connecting a test port cable to the VNA test port, take steps to eliminate the static charges built-up on the test port cable. This can be done by terminating the open-end of the cable with the short from the calibration kit and then grounding the outer conductor of the connector on the cable.

2-5 Calibration and Measurement Conditions

Extremes in the surrounding environmental conditions and the condition and stability of the test port connectors, through cable, and calibration kit determine system measurement integrity to a large extent. These are all user controlled conditions, and as such, should be evaluated periodically for impact on system performance. If these conditions vary significantly with time, the system verification procedures should be performed more often than the recommended annual cycle.

The standard conditions specified below must be observed when performing any of the operations in this chapter – both during calibration and during measurement.

- Warm-up Time:
 - 45 minutes
- Environmental Conditions
 - Temperature
 - For system verification, $23\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$, with $< 1\text{ }^{\circ}\text{C}$ variation from calibration temperature
 - For other tests, $25\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$
 - Relative Humidity
 - 20 % to 50 % recommended

2-6 System Verification

The system verification procedures verify the measurement capabilities of the VNA, calibration kit, test port cables, and any required adapters as a system by analyzing the measurement of artifacts that are traceable to national standards laboratories. The procedures are automated by using the MS46522A System Verification Software – 2300-560-R, in conjunction with the appropriate Anritsu Calibration and Verification Kits listed in the table below.

Table 2-1. Equipment Required for System Verification

Equipment	Critical Specification	Recommended Manufacturer/Model
Calibration Kit	Frequency: DC to 8.5 GHz Connector: N Type	Anritsu Model 3653A
Verification Kit	Connector: N Type	Anritsu Model 3663-2 (3663-1 is also supported)
Adapter	Frequency: DC to 18 GHz Connector: N(m) to K(m)	Anritsu Model 34NK50
Adapter	Frequency: DC to 18 GHz Connector: N(m) to K(f)	Anritsu Model 34NKF50
Torque Wrench	3/4 in. (0.75 in) Open End Wrench 12 lbf·in (1.35 N·m)	Anritsu Model 01-200
RF Coaxial Cable	Frequency: DC to 40 GHz Impedance: 50 ohm Connector: K(f) to K(m)	Anritsu Model 3670K50-2
Interface Cable	Ethernet: RJ48, cross-over, Cat.5E Ethernet: RJ48, Cat.5E	Anritsu Part Number 3-806-152 Anritsu Part Number 2000-1371-R
Personal Computer	Operating System: Windows 7 Interface: Ethernet, RJ-48 Software: National Instruments VISA version 4.4.1 or later	Any
System Verification Software	Medium: USB Flash Drive	Anritsu Part Number 2300-560-R

Caution The use of non-Anritsu calibration kits or verification kits is not supported.

The System Performance Verification Software guides the user to perform a full 12 Term calibration on the VNA using the appropriate calibration kit, measure the S-parameters of the impedance transfer standards in the verification kit, and to verify that the measured values are within the specified measurement uncertainty limits.

The impedance transfer standards contained in the verification kit are:

- 20 dB Attenuation Standard
- 50 dB Attenuation Standard
- 50 Ohm Air Line Standard
- 25 Ohm Mismatch (Beatty) Standard

The devices in the verification kit are selected based on their ability to stress the envelope of possible measurement parameters while still providing a very stable and repeatable behavior. The key attribute of the devices is that of long term stability.

Pass/Fail status of the measurements is displayed on the computer. The software can also provide hardcopy (printout) of the test reports which include the measured data, the measurement uncertainties, and the Pass/Fail status.

Verification Result Determination

The software verification process compares the measured S-parameter data of the impedance transfer standards against the original standard (characterization) data for those devices that was obtained using the factory standard vector network analyzer (at Anritsu). The factory standard vector network analyzer system is traceable to NIST through the impedance standards of the Anritsu calibration laboratory. These standards are traceable to NIST through precision mechanical measurements, NIST-approved microwave theory impedance derivation methods, and electrical impedance comparison measurements.

At each frequency point, the verification measurement is compared to the characterization measurement in the context of the uncertainties. If the delta between the two measurements is consistent with the uncertainty window, the measurement is considered acceptable at that point. The metric of comparison, termed E_n , is a check to see if the measurement differences are consistent with the uncertainty windows of both the characterization and the verification *measurements*. The quantity is shown in the formula below:

$$E_n = \frac{|X_{xy}^{\text{char}} - X_{xy}^{\text{ver}}|}{\sqrt{(U_{xy}^{\text{char}})^2 + (U_{xy}^{\text{ver}})^2}}$$

where:

- The numerator contains the magnitude or phase of S-parameters measured during characterization (by Anritsu) and during verification (by the user).
- The denominator contains the respective uncertainties.

These uncertainties are calculated based on the VNA, the calibration kit, and repeatability. If this quantity E_n is less than 1, then the measurements during the two phases are within the overlap of the uncertainties and one can consider the measurements “equivalent” and, in some sense, verified.

The quality of the verification results is very dependent on the degree of care taken by the user in maintaining, calibrating, and using the system. The most critical factors are:

- The stability and quality of the devices in the calibration kit and verification kit.
- The condition of the VNA test port connectors and test port cables.
- The pin depths of all connectors and the proper torquing of connections. These same factors also affect the VNA measurement quality.

Consult the reference manual supplied with Anritsu Calibration Kits and Verification Kits for proper use, care, and maintenance of the devices contained in these kits.

2-7 System Verification Procedure

The system verification procedure is described below. The procedure assumes that the system verification software has been installed to an external personal computer running Microsoft Windows operating system and the National Instruments VISA runtime.

Equipment Required

- Personal Computer:
 - With Microsoft Windows operating system
 - With National Instruments VISA runtime
 - Ethernet interface cable
- Anritsu Calibration Kit (Refer to [Table 2-1, “Equipment Required for System Verification” on page 2-5](#))
- Anritsu Verification Kit (Refer to [Table 2-1](#))
- Anritsu Test Port Cables (Refer to [Table 2-1](#))

Special Precautions

When performing the procedures, observe the following precautions:

- Minimize vibration and movement of the system, attached components, and test cables.
- Clean and check the pin depth and condition of all adapters, test port cables, calibration components, and impedance transfer standards.
- Preshape the test cables so as to minimize their movement during calibration and measurement activities.

Test Sequence

The user can run all the automated tests in a consecutive fashion or run individual test selectively.

If all are selected, the test sequence is:

- VNA Calibration
- Airline (DAT) Measurements
- Airline (UNC) Uncertainty Computation [Pass/Fail Determination]
- Beatty Airline (DAT) Measurements
- Beatty Airline (UNC) Uncertainty Computation
- 20 dB Offset (Pad) (DAT) Measurements
- 20 dB Offset (Pad) (UNC) Uncertainty Computation
- 50 dB Offset (Pad) (DAT) Measurements
- 50 dB Offset (Pad) (UNC) Uncertainty Computation

Test Reports

Each test generates a data report file in TEXT(ASCII) file format. The data report files can be viewed and printed either using the software built-in “Print” function or other software applications, such as Notepad or other word processors. The data report files are:

- 20DB OFFSET (UNC) #VER.TXT
- 50DB OFFSET (UNC) #VER.TXT
- AIRLINE (UNC) #VER.TXT
- BEATTY (UNC) #VER.TXT

These files can be found in the following folder on the hard drive of the PC controller:

C:\Anritsu ShockLine Verification\VNA_Reports\MS46522A_xxxxxxx

[where xxxxxxx is the serial number of the MS46522A being tested]

Procedure

1. Turn on power to the PC controller.
2. Use a Cat5-E Ethernet cable to connect the ShockLine MS46522A to a local area network port that is close to the PC controller. Alternatively, use a Cat5-E Ethernet crossover cable to connect the ShockLine MS46522A directly to the PC controller Ethernet port. Refer to the MS46522A Operation Manual, PN 10410-00330, for setup procedures.
3. Turn on the ShockLine MS46522A and allow the instrument to warm up for 45 minutes.
4. Prepare the through cable as follows:
 - a. Install the 34NK50 and 34NKF50 adapters to the 3670K50-2 through cable. Use torque wrench to tighten the K connectors to insure that the connections do not work themselves loose during the test.
 - b. Install the through cable with the adapter to Port 2 of the ShockLine MS46522A.

Caution	Use an appropriate torque wrench to insure proper connection of calibration devices during calibration.
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5. Run the ShockLine MS46522A verification software on the PC.
6. Verify that the PC controller is communicating with the ShockLine MS46522A.
7. Insert the USB flash drive that is supplied with the verification kit to an available USB port on the PC controller. Set the data location of the verification software to the USB flash drive when prompted.
8. Follow the directions that are displayed on the computer to perform the calibration with the four impedance transfer standards for the appropriate calibration kit.
9. After all tests have been completed, print the test results and attach the printouts to the test record in [Appendix A, "ShockLine MS46522A Test Record"](#)

If Verification Fails

If the verification fails, then check the quality, cleanliness, and installation methods for the calibration and verification components. Specifically, check for the most common causes for verification failures:

- The VNA test port connectors
- The calibration tee
- The impedance transfer standards
- The test port cables, for damage and cleanliness
- The test port cables, for proper connection and torquing
- The test port cables, for phase stability

Chapter 3 — Adjustment

3-1 Introduction

This chapter contains procedures that are used to restore and optimize the operation of the MS46522A Vector Network Analyzer.

3-2 Adjustment Menu Access

The hardware adjustment functions are accessed by selecting the Diagnostics button under the System menu. The Diagnostics menu is password-protected to prevent a casual VNA user from changing the correction coefficients inadvertently.

Procedure

To access the DIAGNOSTICS menu, do the following:

1. Plug in the PC keyboard, PC mouse and PC monitor to the rear panel of the VNA.
2. Power on the VNA and wait until the ShockLine application is running.
3. Select the System button on the right-side menu.
4. Select the Diagnostics button.
5. The Diagnostics Access dialog box appears providing an entry field to enter the diagnostics access password as shown below in [Figure 3-1](#).

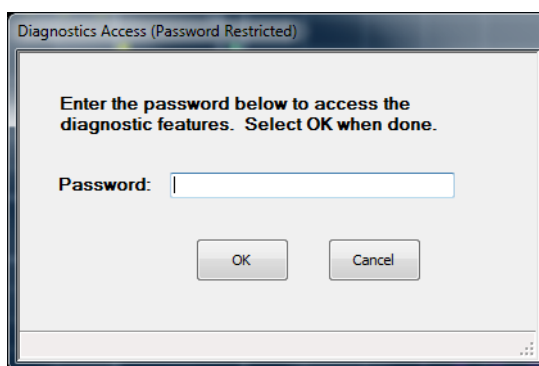


Figure 3-1. Diagnostics Access Dialog Box

6. Enter the password ModVna in the Password field and click OK.

7. The DIAGNOSTICS menu appears as shown below in [Figure 3-2](#).

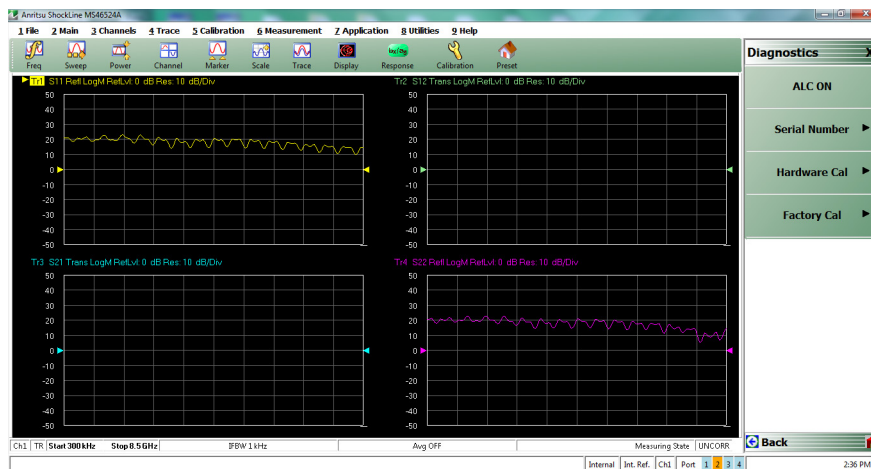


Figure 3-2. Diagnostics Menu

8. Select the Hardware Cal button to access the HARDWARE CAL menu as shown in [Figure 3-3](#).

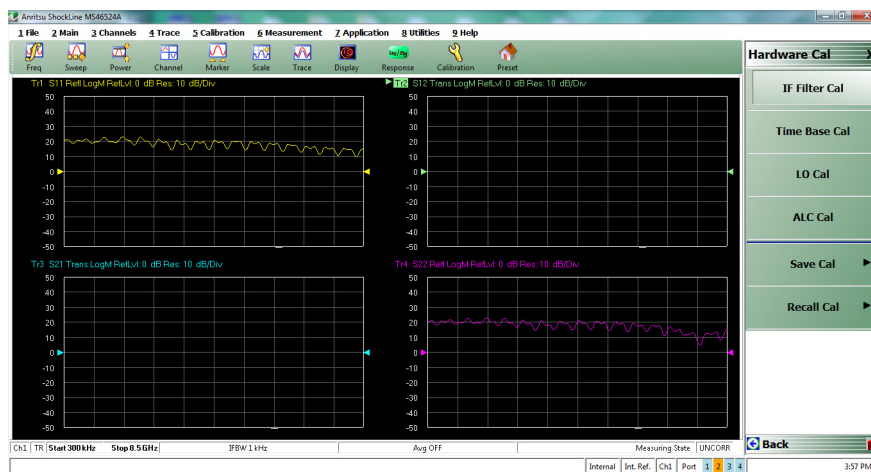


Figure 3-3. Hardware Cal Menu

3-3 ALC Adjustment Procedure

This section provides the procedure to restore or optimize the operation of the MS46522A related to the RF leveling at the VNA test ports.

Note Performing the ALC adjustment procedure is normally not required after the VNA module assembly has been replaced. Each replacement VNA module is fully pre-calibrated / pre-adjusted prior to shipping from the factory.

Equipment Required

- Anritsu Model ML2438A Power Meter
- Anritsu Model SC7400 Power Sensor
- National Instruments Model GPIB-USB-HS USB to GPIB Adapter
- Aeroflex/Weinschel Model 44-10, 10 dB Fixed Attenuator

Procedure

1. Install the power sensor to the power meter, and then power on the power meter.
2. Power on the VNA and allow the instrument to warm up for at least 45 minutes.
3. Select File | Exit to shut down the ShockLine application software.
4. Install the National Instruments GPIB software that is supplied with the GPIB adapter to the VNA. Follow the instructions that are supplied by National Instruments.
5. Insert the USB end of the USB to GPIB adapter to an open USB port on the rear panel of the VNA and wait for the operating system software of the VNA to load the required driver for operation.
6. When the 'ready' message appears on the VNA, connect the GPIB end of the USB to GPIB adapter to the GPIB port of the power meter.
7. Launch the ShockLine application software from the Windows desktop.
8. Access the Hardware Cal menu. Refer to [“Adjustment Menu Access”](#) on page 3-1.

Port 1 ALC Cal

9. Select the Port 1 ALC Cal button. The Port1 ALC Cal dialog box appears as shown below in [Figure 3-4](#).

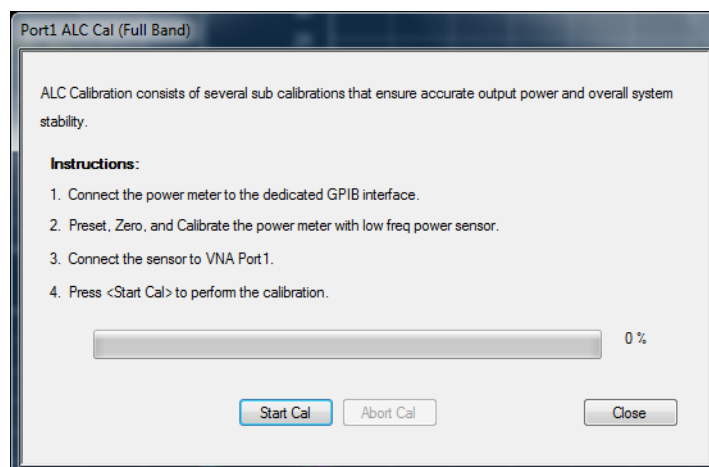


Figure 3-4. Port1 ALC Cal Dialog Box

10. Zero the power sensor and then install the 10 dB fixed attenuator to the power sensor input.

11. On the power meter, set the **Sensor Offset** value to 10 dB via:
Sensor → More → Offset → Type: Fixed → Value: 10 dB
12. Connect the power sensor with the 10 dB attenuator attached to VNA Port 1.
13. Select the **Start Cal** button to begin the calibration (adjustment).
14. When the calibration is complete, select the **Close** button and disconnect the power sensor from VNA Port 1.

Port 2 ALC Cal

15. Select the Port 2 ALC Cal button. The Port2 ALC Cal dialog box appears as shown in [Figure 3-5](#).

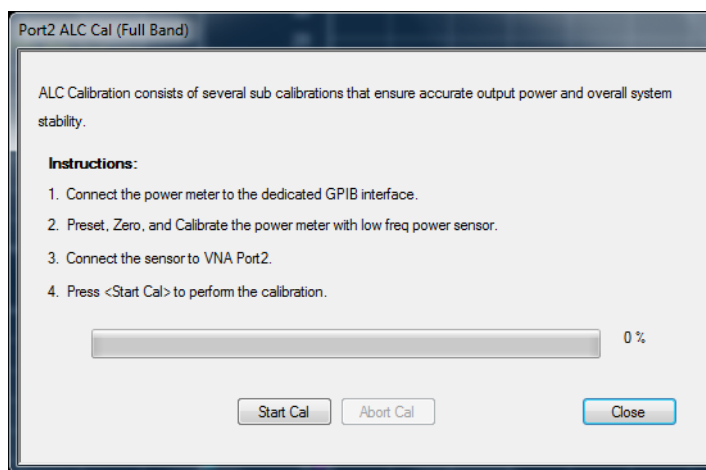


Figure 3-5. Port 2 ALC Cal Dialog Box

16. Zero the power sensor, if required.
17. Connect the power sensor to VNA Port 2.
18. Select the **Start Cal** button to begin the calibration.
19. When the calibration is complete, select the **Close** button and disconnect the power sensor from VNA Port 2.
20. Save the calibration by selecting: **Back** → **Save Cal** → **ALC Cal** → **Save**
21. Exit the ShockLine application and then re-launch it from the Windows desktop.

3-4 10 MHz Time Base Adjustment

This section provides the procedure to restore or optimize the operation of the MS46522A related to the frequency accuracy of a VNA test port stimulus signal.

Note	Performing the 10 MHz time base adjustment procedure is normally not required after the back plane assembly has been replaced. Each replacement back plane is fully pre-calibrated / pre-adjusted prior to shipping from the factory.
-------------	---

Equipment Required

- Symmetricom Model RubiSource T&M 10 MHz reference standard or equivalent
- Anritsu part number 2000-1627-R BNC(m) to BNC(m) 50 ohm coaxial cable

Procedure

1. Power on the 10 MHz reference standard.
2. Power on the VNA and allows the instrument to warm up for at least 45 minutes.
3. Connect the BNC(m) to BNC(m) coaxial cable between the 10 MHz reference standard output and the 10 MHz In connector on the rear panel of the MS46522A.
4. Access the Hardware Cal menu. Refer to [“Adjustment Menu Access” on page 3-1](#).
5. Press the Time Base Cal button, then press the OK button to start the automated process.

Note	Some early production instruments do not support automated time base calibration. For these units, follow the instruction on the display to perform a manual adjustment.
-------------	--

6. Save the calibration by selecting: Back → Save Cal → Time Base Cal → Save
7. Exit the ShockLine application and then re-launch it from the Windows desktop.

3-5 Factory RF Calibration (RF Cal)

The Factory RF Calibration represents a subset of a 12-term calibration so that simple reflection and transmission standards will read somewhat close to their true value, even without a User Measurement Calibration.

Equipment Required

- Anritsu 3653A N Connector Calibration Kit
- Coaxial Through Cable, male to male, consist of:
 - 3670K50-2 K(m) to K(f) Through Cable
 - 34NK50 N(m) to K(m) Adapter
 - 34NKF50 N(m) to K(f) Adapter

Procedure

1. Warm up the VNA for at least 45 minutes.
2. If the length of the through line cable is not known, perform the Length Determination Procedure in Section “Through Line Length Determination Procedure”.
3. Preset the VNA and then access the **FACTORY CAL** menu as described above in [Section 3-2 “Adjustment Menu Access”](#).

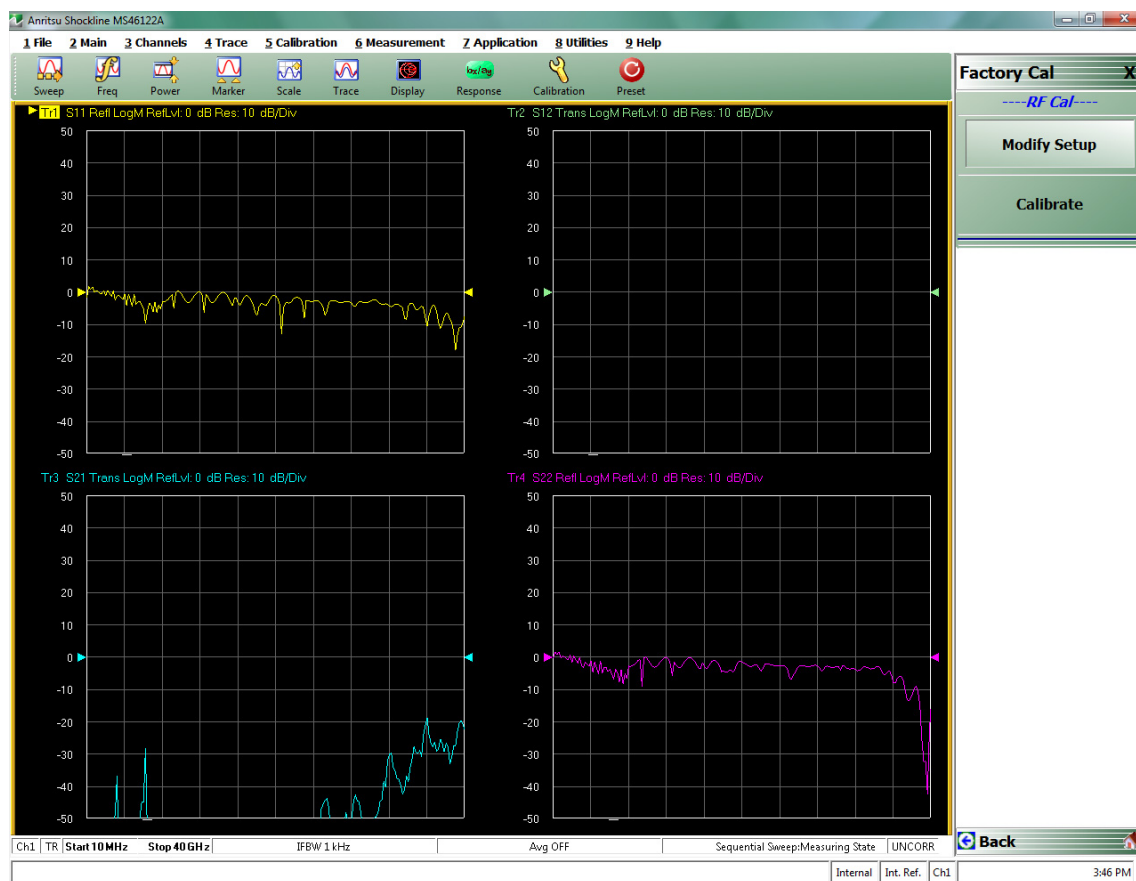


Figure 3-6. Factory Cal Menu

- Select the Modify Setup button under RF Cal to display the **Factory RF Cal Setup** dialog box.

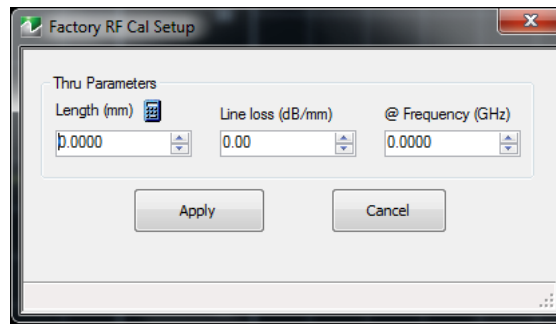


Figure 3-7. Factory RF Cal Setup Dialog

- Change the parameters in the dialog box as shown in the table below, then click the Apply button when done.

Table 3-1. Parameter Changes for Factory RF Calibration

Thru Length (mm)	Line Loss (dB)	@ Frequency (GHz)
Actual length of through including adapters, if used.	0.009 After the value above is entered, it will round up to 0.01.	70

- Select the Calibrate button to display the **Factory RF Cal** dialog box ([Figure 3-8](#)).

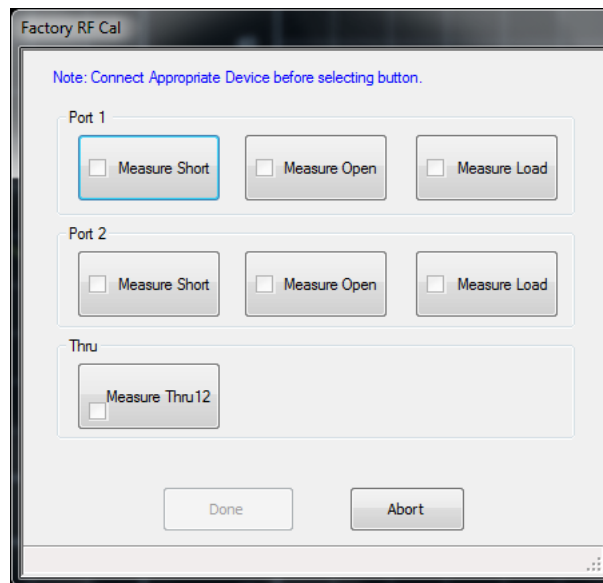


Figure 3-8. Factory RF Cal Dialog

- Connect each calibration standard from the calibration kit in sequence to the appropriate port. Click the appropriate button when ready.
- When all seven (7) calibration standards have been measured, click the Done button to complete the procedure.

3-6 Through Line Length Determination Procedure

This procedure is used to determine the length of the through line cable (including adapters) that is used for Factory RF Calibration and Factory Phase Calibration.

Equipment Required

- Anritsu 3653A N Connector Calibration Kit

Procedure

1. Preset the VNA.
2. Select the Frequency button on the right side menu and set the number of points to 801.
3. Select the Calibration button.
4. Insert the USB memory device from the calibration kit into the USB port on the front panel of the instrument. The red indicator LED on the USB memory device will flash and then light constantly.
5. Select the Cal Kit/AutoCal Characterization button, then select the Install Kit/Charac button to display the **Load** dialog box (Figure 3-9).
6. Select the Cal Kit radio button and then click the browse button.

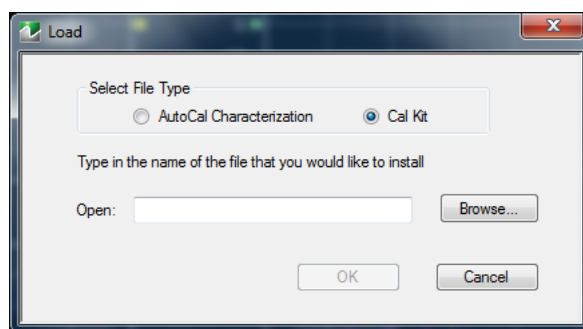


Figure 3-9. Load (Characterization/Cal Kit) Dialog Box

7. Locate Removable Disk (x:), where x is the drive letter designated to the USB drive by Windows.
8. Double-click Removable Disk (x:), then select the “xxxxxxxx.ccf” file, and then click Open.
9. In the **Load** dialog box, click OK to load the coefficients.
10. Click the Back icon to return to the **CALIBRATION [TR]** menu.
11. Select the Calibrate button and then the Manual Cal button.
12. Select the 1-Port Cal button and then Edit Cal Params. Uncheck Test Port 2 and change Test Port 1 DUT Connector to N-Conn(M).
13. Click the OK button when done, then click on the Back icon to return to the previous menu. Select Port 1 Reflective Devices.
14. Connect the male Open calibration standard to VNA Port 1 and then select the Open button to start the measurement. When done, a check mark appears on the Open button to indicate the existence of a calibration.
15. Disconnect the Open, connect the male Short calibration standard to VNA Port 1, and then select the Short button to start the measurement.
16. Disconnect the Short, connect the male Load calibration standard to VNA Port 1, and then select the Load button to start the measurement.
17. Disconnect the Load calibration standard and click the Done button.

18. Connect a female short to one end of the through cable (DUT).
19. Connect the open end of the through cable to VNA Port 1.
20. Click the **Measurement** button, then click the **Reference Plane** button, and then click the **Auto** button.
21. Subtract 8.966 mm from the displayed **Distance** value. This is the Length of the through cable used for the **Factory RF Calibration**.
22. Enter 0 to the **Distance** button to reset the value.

Chapter 4 — Troubleshooting

4-1 Introduction

This chapter provides information about troubleshooting tests that can be used to check the MS46522A Vector Network Analyzer for proper operation. These tests are intended to be used as a troubleshooting tool for identifying the faulty components and checking the functionality of internal components and sub-assemblies in the MS46522A VNA.

Only qualified service personnel should replace internal assemblies. Major subassemblies that are shown in the replaceable parts list are typically the items that may be replaced. Because they are highly fragile, items that must be soldered may not be replaced without special training. Removal of RF shields from PC boards or adjustment of screws on or near the RF shields will de-tune sensitive RF circuits and will result in degraded instrument performance.

4-2 General Safety Warnings

Many of the troubleshooting procedures presented in this chapter require the removal of instrument covers to access sub-assemblies and modules. When using these procedures, please observe the warning and caution notices.

Warning	Hazardous voltages are presented inside the instrument when AC line power is connected. Before removing any covers, turn off the instrument and unplug the AC power cord.
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Caution	Many assemblies and modules in the MS46522A VNA contain static-sensitive components. Improper handling of these assemblies and modules may result in damage to the assemblies and modules. Always observe the static-sensitive component handling precautions.
----------------	--

4-3 Troubleshooting Test – Power Supply DC Check

This procedure verifies that the expected DC voltages are present at the power supply and the back plane PCB assembly in the MS46522A VNA.

Equipment Required

- Digital Multimeter

Reference Figures

- [Figure 4-1](#) shows the power supply +3.3 V terminal, +12 V terminal and their respective ground terminals.
- [Figure 4-2](#) shows both the front and back sides of the back plane PCB assembly to help locate the E2 test point and the P16 5 V connector.



Figure 4-1. Power Supply Output Terminals

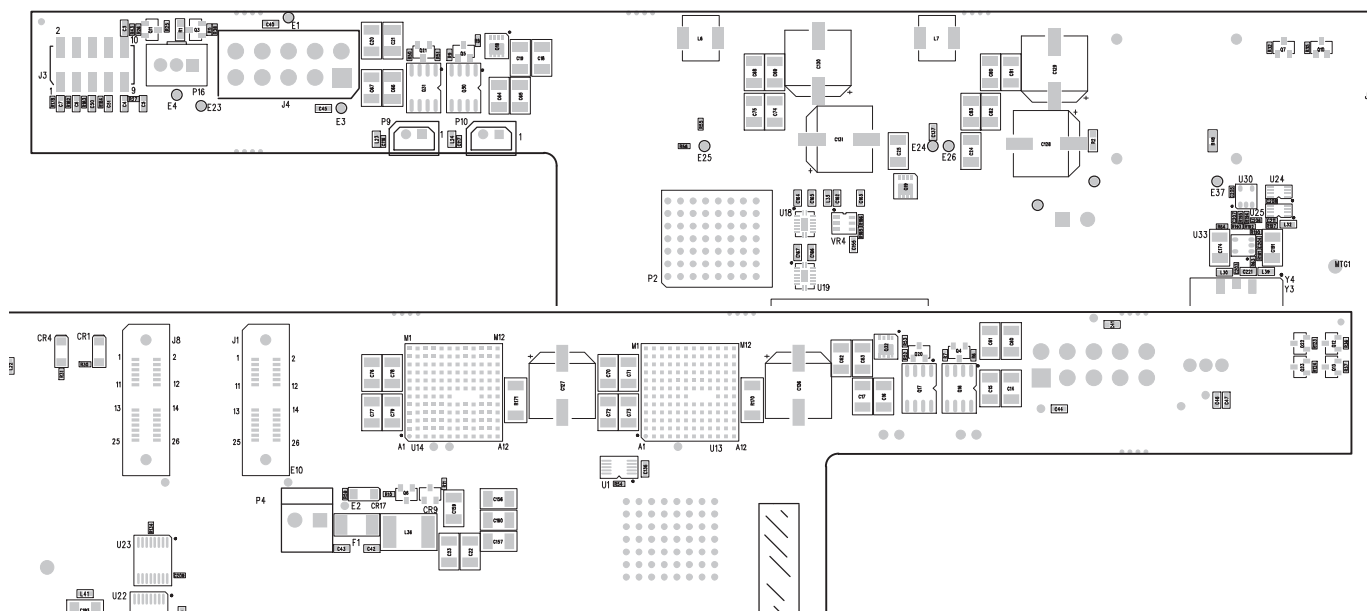


Figure 4-2. Back Plane PCB Assembly

Procedure

1. Turn off the MS46522A VNA and unplug the AC power cord, mouse, keyboard and external monitor.
2. Remove the top cover.
3. Re-connect the AC power cord, mouse, keyboard and external monitor.
4. Turn the MS46522A VNA on.
5. Use the digital multimeter to measure the DC voltages at the test points stated in [Table 4-1](#).

Table 4-1. Expected DC Bias Voltages

Test Point	Common	Expected Voltage
Power Supply +3.3 V Terminal	Power Supply +3.3 V GND Terminal	+3.7 V
Power Supply +12 V Terminal	Power Supply +12 V GND Terminal	+12.5 V
Back Plane PCB Assy P16 pin 3	Back Plane PCB Assy P16 pin 2	+5 V
Back Plane PCB Assy P4 pin 1 (or E2)	Back Plane PCB Assy P4 pin 2	+19 V

Note When measuring the DC voltage on Back Plane PCB Assembly, place the test probes on the back side of the specified connector.

6. If the +5 V, +3.7 V or +12.5 V are not present, replace the power supply.
7. If the +19 V is not present, replace the back plane PCB assembly.
8. If the voltage at the +3.3 V terminal or +12 V terminal is not at the expected level, unplug the power supply cables from the back plane PCB assembly and adjust the power supply voltage using a tuning screwdriver. If not adjustable, replace the power supply.

4-4 Troubleshooting Test - Non-Ratio Power Level Check

The non-ratio power level check verifies the VNA module assembly for faults.

Equipment Required

- Anritsu Model 3670K50-2 RF Coaxial Cable
- Anritsu Model 34NK50 N(m) to K(m) Adapter
- Anritsu Model 34NKF50 N(m) to K(m) Adapter

Procedure

1. Install the 34NK50 and 34NKF50 adapters to the 3670K50-2 RF coaxial cable to convert both ends into N(m) connector port.
2. Turn on the MS46522A.
3. Connect the coaxial cable between test port 1 and test port 2.
4. Select Trace 1 and then select Display | Trace Format. Set Trace Format to Log Mag.
5. Select Response | User-defined. The User-defined menu appears.
6. Set Numerator to A1, Denominator to 1, and Driver Port to Port 1.
7. Use a mouse to move the reference line to one graticule below top scale.
8. Repeat Step 4 thru step 7 for Trace 2, setting Numerator to B2, Denominator to 1, and Driver Port to Port 1.
9. Repeat Step 4 thru step 7 for Trace 3, setting Numerator to B1, Denominator to 1, and Driver Port to Port 2.
10. Repeat Step 4 thru step 7 for Trace 4, setting Numerator to A2, Denominator to 1, and Driver Port to Port 2.
11. Observe whether any portions of these traces show any abnormality (for example, very low power level).

4-5 Troubleshooting Turn-on Problems

Unit Cannot Boot Up

Unit cannot boot up, no activity occurs when the **Operate/Standby** key is pressed:

1. Perform the power supply DC check as described in [“Troubleshooting Test - Power Supply DC Check” on page 4-2](#).
 - a. If +3.3 V, +5 V or +12 V are not present, replace the power supply.
 - b. If +19 V is not present, replace the back plane PCB.
2. If all voltages are present and the CPU fan is not running, ensure that all of the cables from the back plane assembly to the CPU assembly are properly connected and secure.
3. If the fan is still not running, replace the CPU assembly.

Unit Cannot Boot into Windows OS environment

1. Remove the solid state drive from the VNA and attach it to a USB to SATA adapter.
2. Install the USB to SATA adapter to a USB port of a personal computer that has anti-malware installed.
 - a. If the PC could not recognize the solid state drive, replace it with a new solid state drive.
3. Perform the malware scan.
 - a. If malware is found, remove the malware, then install the solid state drive back to the VNA and verify that the VNA can boot into Windows and launch ShockLine application.
 - b. If problem still exists, replace the solid state drive.

Unit Cannot Launch ShockLine Application

Unit can boot to Windows but does not launch the ShockLine application:

1. A ShockLine application software update may not have completed. Re-install the software.
2. Open Windows Device Manager and verify the Anritsu PCIe device is present. If not, check the cable connection between the back plane PCB and Full Mini PCIe PCB, replace the Full Mini PCIe PCB, replace the solid state drive, and then replace the VNA module assembly.

4-6 Troubleshooting Operating Problems

Frequency Related Problems

If the instrument exhibits frequency related problems, do the following:

1. Perform the [“10 MHz Time Base Adjustment”](#) on page 3-5. If the adjustment does not help, go to the next step.
2. Apply an external 10 MHz reference to the rear panel **10 MHz Ref In**.
3. If the problem does not show with the external reference, the problem is in the internal reference oscillator. Replace the back plane PCB assembly.
4. If the problem still exists, replace the VNA module assembly.

RF Power Related Problems

If the instrument exhibits RF power related problems, do the following:

1. Perform the [“Troubleshooting Test - Non-Ratio Power Level Check”](#) on page 4-4.
2. If the power level shows any abnormality, do the following:
 - a. Verify that the flexible coaxial cable connection between test port adapter and VNA module assembly is secure. Re-torque if necessary.
 - b. Verify that the test port adapter is not worn or damaged. Replace the test port adapter if necessary.
 - c. Replace the VNA module assembly.

4-7 Troubleshooting Measurement Problems

If the MS46522A measurement quality is suspect, the following paragraphs provide guidelines and hints for determining possible quality problems.

VNA Measurement Quality

The quality of the MS46522A VNA measurements is determined by the following:

- The condition of the MS46522A.
- The quality and condition of the interface connections and connectors.
- The quality and condition of the calibration components, through cables, adapters, and fixtures.
- The surrounding environmental conditions at the time of the measurement.
- The selection and performance of the calibration for the DUT being measured.

Checking Possible Measurement Problems

When determining possible measurement problems, check the following items:

1. Check the DUT and the calibration conditions:
 - a. Ensure that the calibration components coefficients data has been installed into the VNA for the calibration kit in use.
 - b. Ensure that the proper calibration was done for the device being measured:
 - For high insertion-loss device measurements, the calibration should include isolation, high number of averages, and a narrow IF bandwidth setting during calibration.
 - For high return-loss device measurements, a high quality precision load should be used during calibration.
 - c. Check the condition of mating connectors and their pin depth.
 - d. If possible, measure an alternate known good device.
 - e. Check if the environment is stable enough for the accuracy required for the device measurement.
 - The VNA should not be subjected to variations in temperature.
 - The VNA should not be placed in direct sunlight or next to a changing cooling source, such as a fan or air conditioning unit.
2. Check the calibration using known good components from the calibration kit. If measurements of these devices do not produce good results, try the following:
 - a. Check through-cable stability including connector condition and pin depth. Replace with a known good cable, if necessary.
 - b. Check the condition and pin depth of the calibration kit components. Replace with known good components, if necessary.
 - c. Check the condition and pin depth of the test port adapters. Replace with known good adapters, if necessary.
3. Check the system performance as described in [Chapter 2, “Performance Verification”](#)

Chapter 5 — Assembly Removal and Replacement

5-1 Introduction

This chapter describes the removal and replacement procedures for the various assemblies. Illustrations (drawings or photographs) in this manual may differ slightly from the instrument that you are servicing, but the basic removal and replacement functions will remain as specified. The illustrations are meant to provide assistance with identifying parts and their locations.

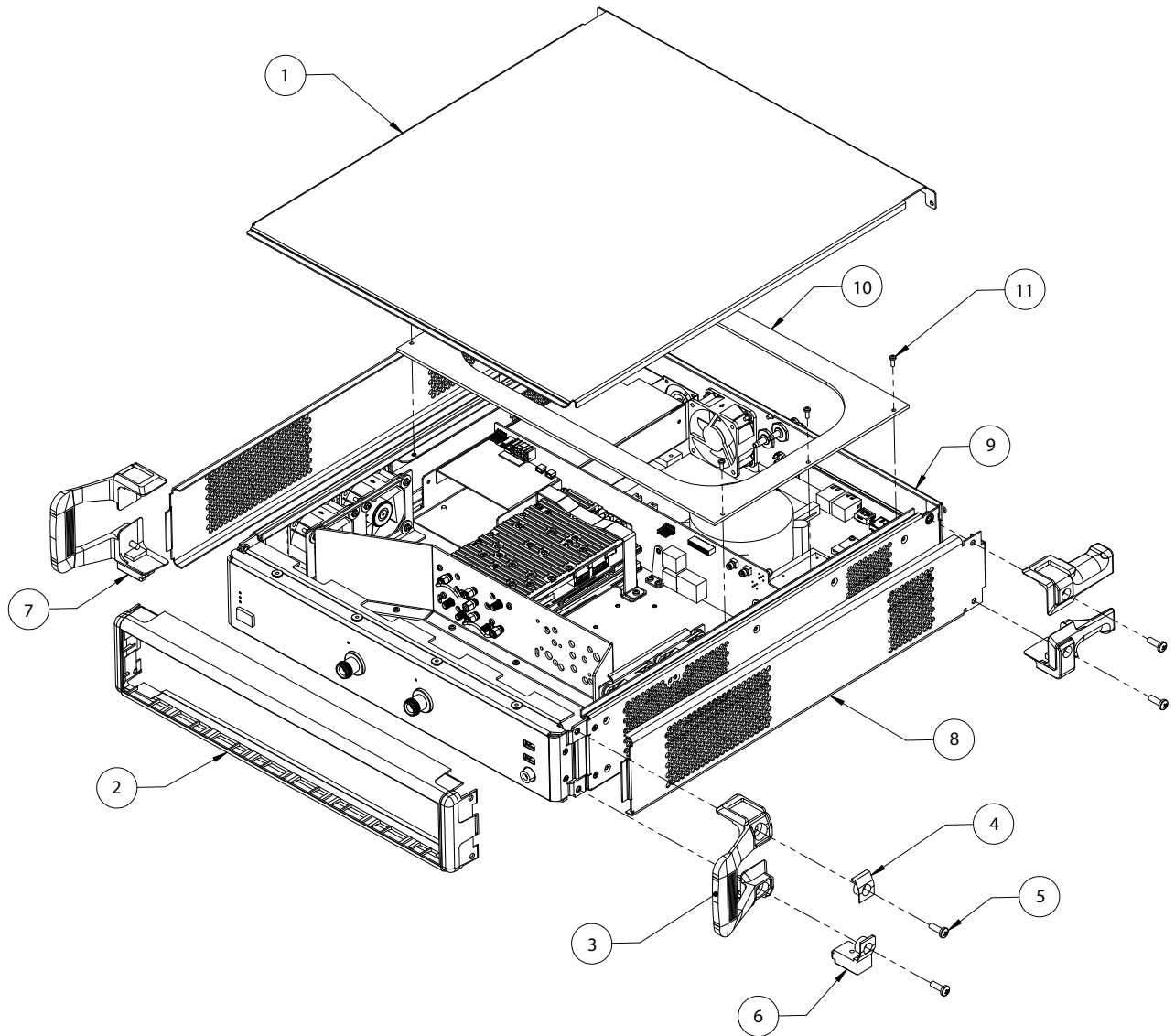
5-2 Electrostatic Discharge Prevention

An ESD safe work area and proper ESD handling procedures that conform to ANSI/ESD S20.20-1999 or ANSI/ESD S20.20-2007 is mandatory to avoid ESD damage when handling subassemblies or components found in the MS46522A Vector Network Analyzer.

<p>Warning All electronic devices, components, and instruments can be damaged by electrostatic discharge. It is important to take preventative measures to protect the instrument and its internal subassemblies from electrostatic discharge.</p>

5-3 Basic Assembly Overview

[Figure 5-1 on page 5-2](#) shows the basic assembly overview of MS46522A Vector Network Analyzer.



- 1 – Top Cover
- 2 – Front Panel Bezel
- 3, 4, 5 – Right Handle, Top Handle Insert and Green Screw
- 6, 7 – Bottom Handle Foot
- 8 – Side Cover
- 9 – Rear Panel
- 10 – Stiffener Plate
- 11 – Stiffener Plate Mounting Screw

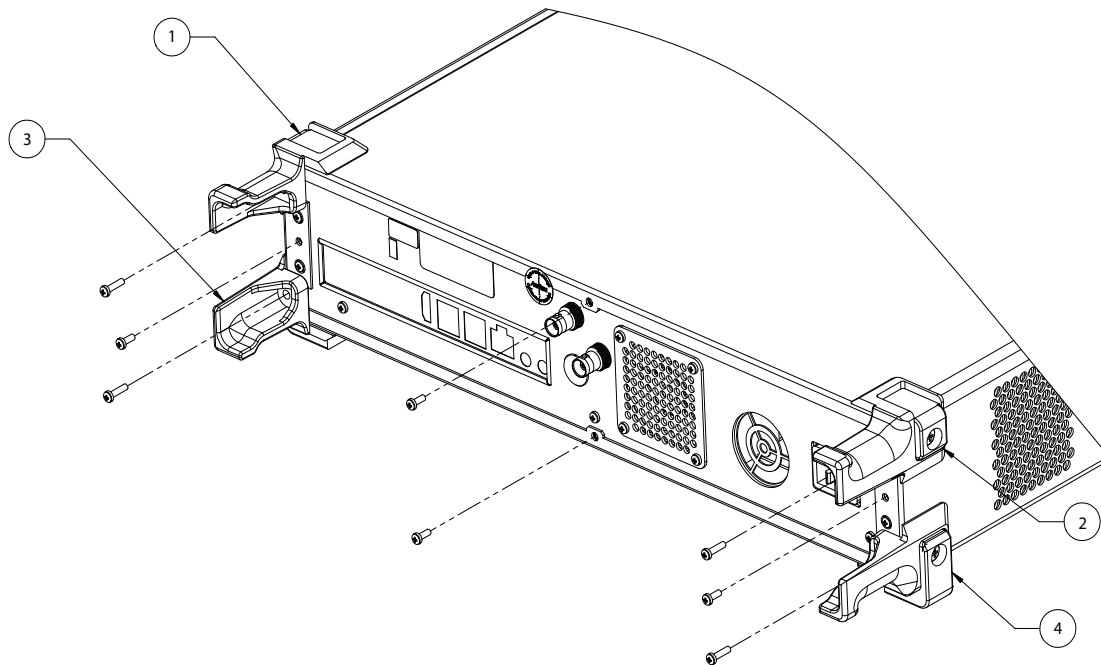
Figure 5-1. MS46522A Basic Assembly Overview

5-4 Disassembly Procedure

Use this procedure to prepare the MS46522A for removal and replacement procedures for all of its replaceable components. Other than the front panel cables, all replacement components require this common disassembly procedure.

Common Disassembly Procedure

1. Prepare a clean and static free work area. Make sure that the work area is well grounded. Cover the work surface with a soft, clean anti-static mat.
2. Provide all personnel with appropriate anti-static grounding wrist straps and similar equipment.
3. Power down the VNA and unplug the AC power cord.
4. Place the VNA on the anti-static mat.
5. Refer to [Figure 5-2 on page 5-3](#) and remove the top cover as follows:
 - a. Remove the two top rear feet.
 - b. Remove the center screw that secures the top cover to the chassis.
 - c. Slide the top cover back and then lift the top cover off the instrument.



1. Top Right Foot
2. Top Left Foot
3. Bottom Right Foot
4. Bottom Left Foot

Figure 5-2. MS46522A Rear Panel

6. Remove the six Phillips screws that secure the stiffener plate to the chassis. Refer to [Figure 5-1 on page 5-2](#).
7. Removing the bottom cover is required when replacing the power supply or the solid state drive of a Revision 1 instrument. Refer to [Figure 5-2 on page 5-3](#) and use the following steps to remove the bottom cover:
 - a. Carefully flip over the instrument so the bottom side is now facing upward.
 - b. Remove the two bottom rear feet.
 - c. Remove the center screw that secures the bottom cover to the chassis.
 - d. Slide the top cover back and then lift the bottom cover off the instrument.

5-5 VNA Module Assembly

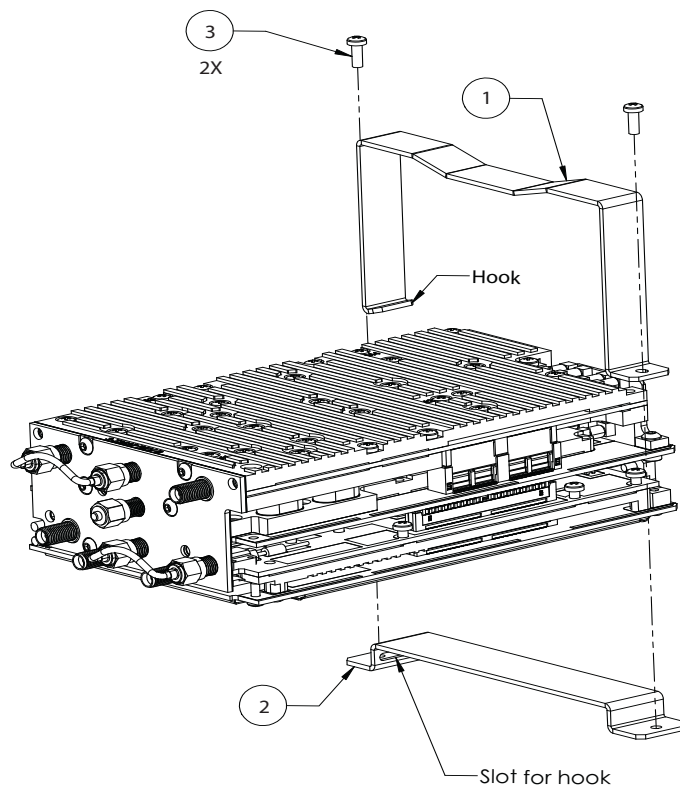
Use this procedure to replace the VNA module assembly. The VNA module assembly is plugged into the back plane PCB assembly. It is secured to the chassis by mounting brackets near the back plane PCB assembly and five (5) Phillips screws are used to secure the assembly to the VNA module mounting plate.

Replacement Parts

- VNA Module Assembly for MS46522A with Option 4 – ND81174
- VNA Module Assembly for MS46522A with Option 10 – ND81175

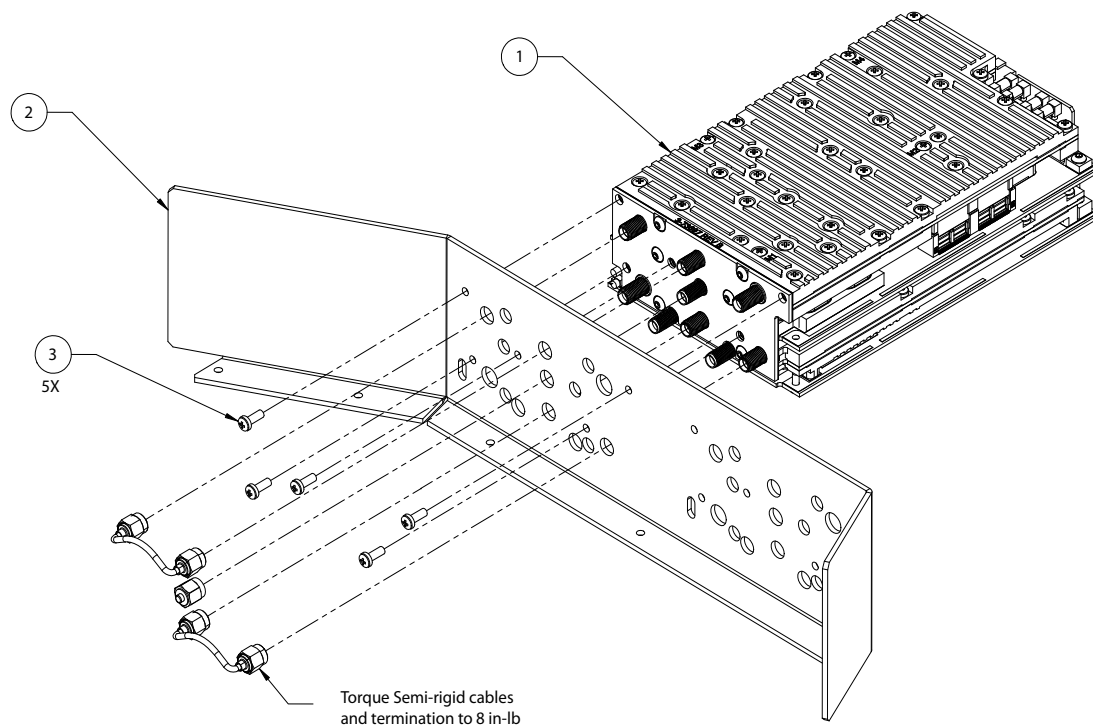
Reference Figures

- [Figure 5-3](#) shows the VNA module assembly with the mounting brackets.
- [Figure 5-4 on page 5-6](#) shows the VNA module assembly with the mounting plate.



-
- 1 – Top Bracket
 - 2 – Bottom Bracket
 - 3 – Mounting Screws
-

Figure 5-3. VNA Module Assembly with Mounting Brackets



1 – VNA Module Assembly

2 – VNA Module Mounting Plate

3 – Mounting screws (5)

Figure 5-4. VNA Module Assembly

Replacement Procedure

1. Remove the top cover as described in the “[Common Disassembly Procedure](#)” on page 5-3.
2. Remove the stiffener plate.
3. Remove the two Phillips screws that secure the VNA module mounting brackets as shown in [Figure 5-3 on page 5-5](#).
4. Remove the mounting brackets.
5. Disconnect the flexible coaxial cables from the VNA module assembly.
6. Remove the five screws that secure the VNA module mounting plate to the chassis.
7. Carefully unplug the VNA module assembly from the back plane PCB assembly and then remove the assembly with the mounting plate from the chassis.
8. Disconnect the two semi-rigid cables and termination from VNA module assembly.
9. Remove the five screws that secure the VNA module assembly to the mounting plate.
10. Carefully separate the mounting plate from the VNA module assembly and then install the termination to the center connector on the second row.
11. Disconnect the termination from the center connector on the replacement VNA module assembly.
12. Place the mounting plate on the replacement VNA module assembly and secure with screws that were removed in Step 9.
13. Install the termination back to the VNA module assembly.
14. Install one semi-rigid cable between the left and middle connectors on the top row.
15. Install the second semi-rigid cable between the center and right connectors on the third row.
16. Torque the connections above to 8 in-lb.
17. Carefully plug the VNA module assembly into the back plane PCB assembly.
18. Secure the mounting plate with screws that were removed in Step 6.
19. Install the mounting brackets and secure with screws that were removed in Step 3.
20. Re-connect Port 1 flexible coaxial cable to the left connector on the third row.
21. Re-connect Port 2 flexible coaxial cable to the right connector on the top row.
22. Re-connect the ‘Trigger In’ flexible cable from the rear panel to the left connector on the bottom row.
23. Torque the cable connection to 8 in-lb.
24. Install the stiffener plate.
25. Install the top cover.

5-6 Full Mini PCIe PCB Assembly

Use this procedure to replace the Full Mini PCIe PCB assembly.

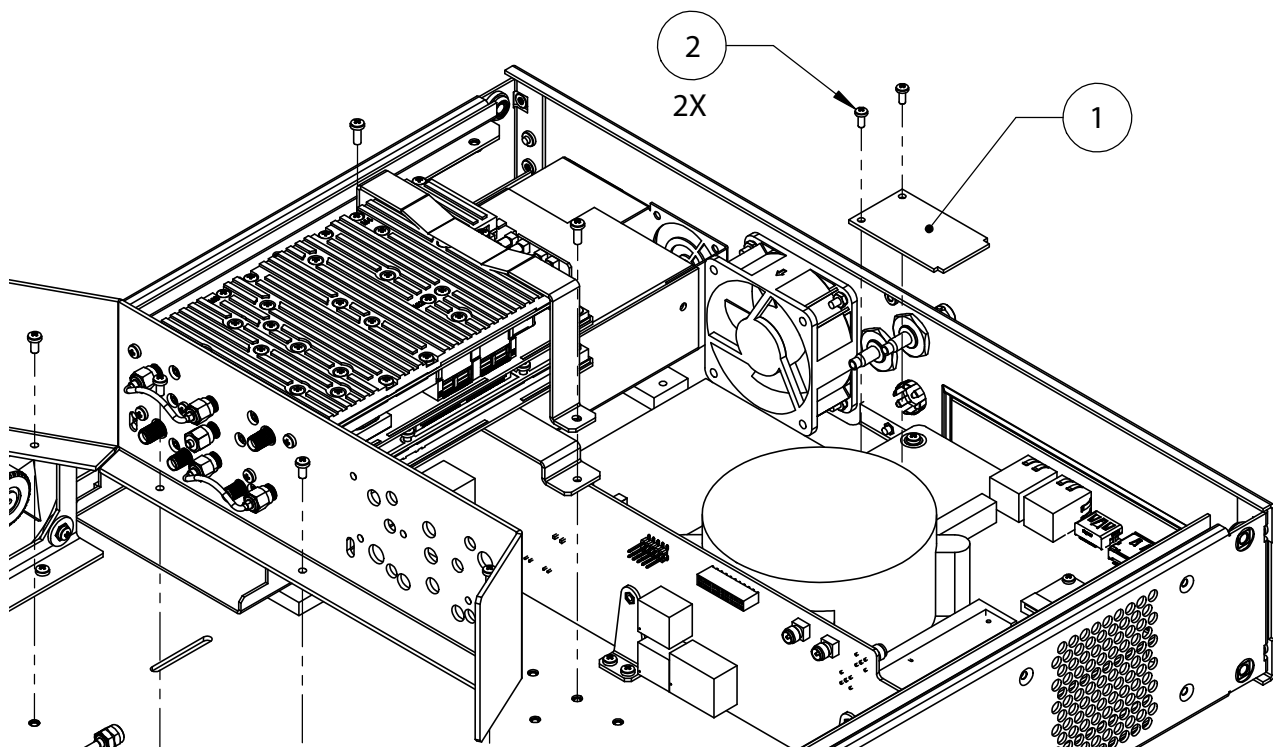
The Full Mini PCIe PCB assembly is plugged into the Full Mini PCIe slot on the motherboard of the CPU assembly and is secured with two Phillips screws.

Replacement Part

- Full Mini PCIe PCB Assembly – ND80985

Reference Figure

- [Figure 5-5](#) below shows the location of the Full Mini PCIe PCB assembly.



1 – Mini PCIe PCB Assembly

2 – Phillips screws

Figure 5-5. Full Mini PCIe PCB Assembly

Replacement Procedure

1. Remove the top cover as described in the [“Common Disassembly Procedure”](#) on page 5-3.
2. Remove the stiffener plate.
3. Disconnect the cable that plugs into the Full Mini PCIe PCB assembly.
4. Remove the two Phillips screws that secure the Full Mini PCIe PCB assembly to the CPU motherboard.
5. Unplug the Full Mini PCIe PCB assembly from the CPU motherboard.
6. Plug the replacement Full Mini PCIe PCB assembly into the connector on the CPU motherboard.
7. Install the screws that were removed in Step 4.
8. Install the stiffener plate.
9. Install the top cover.

5-7 CPU Assembly

Use this procedure to replace the CPU assembly and Mini PCIe PCB assembly.

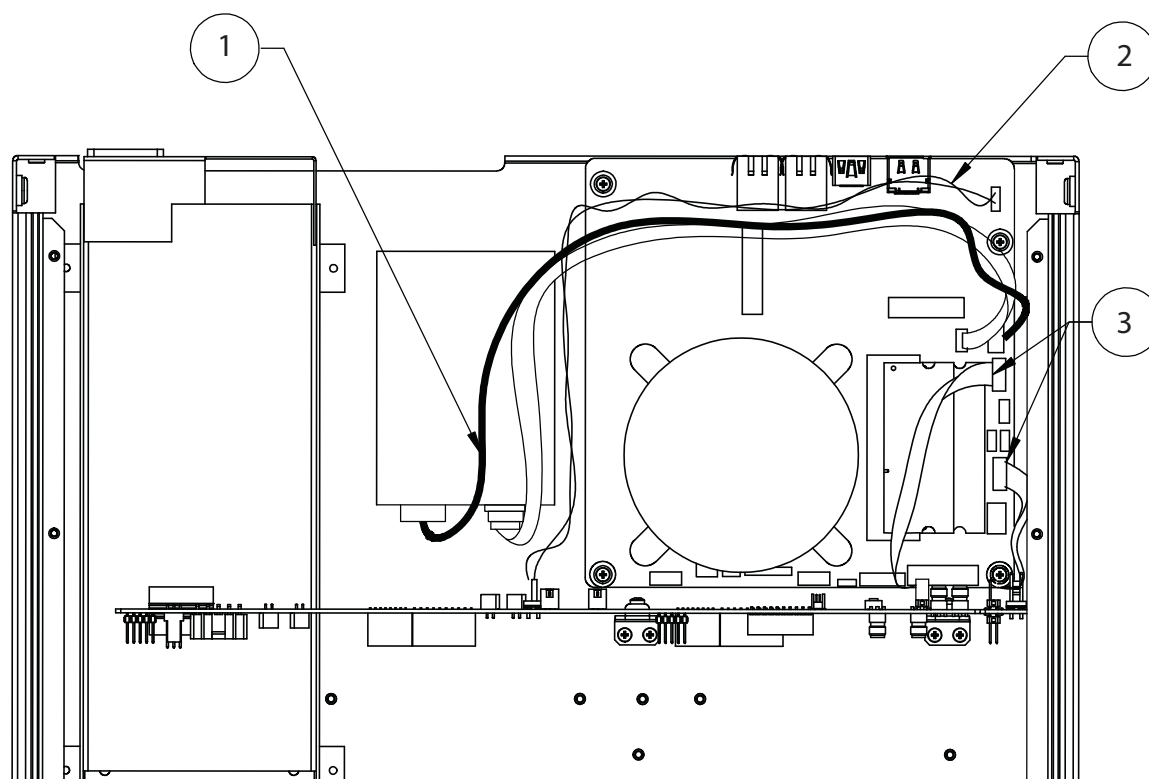
The CPU assembly has the main processor and SODIMM modules already installed and has been pre-tested as a single assembly.

Replacement Part

- CPU Assembly – ND80983

Reference Figures

- [Figure 5-6](#) below shows the cable connections among the CPU assembly, solid state drive, and back plane PCB assembly.
- [Figure 5-7 on page 5-11](#) shows how the CPU assembly is mounted to the chassis.

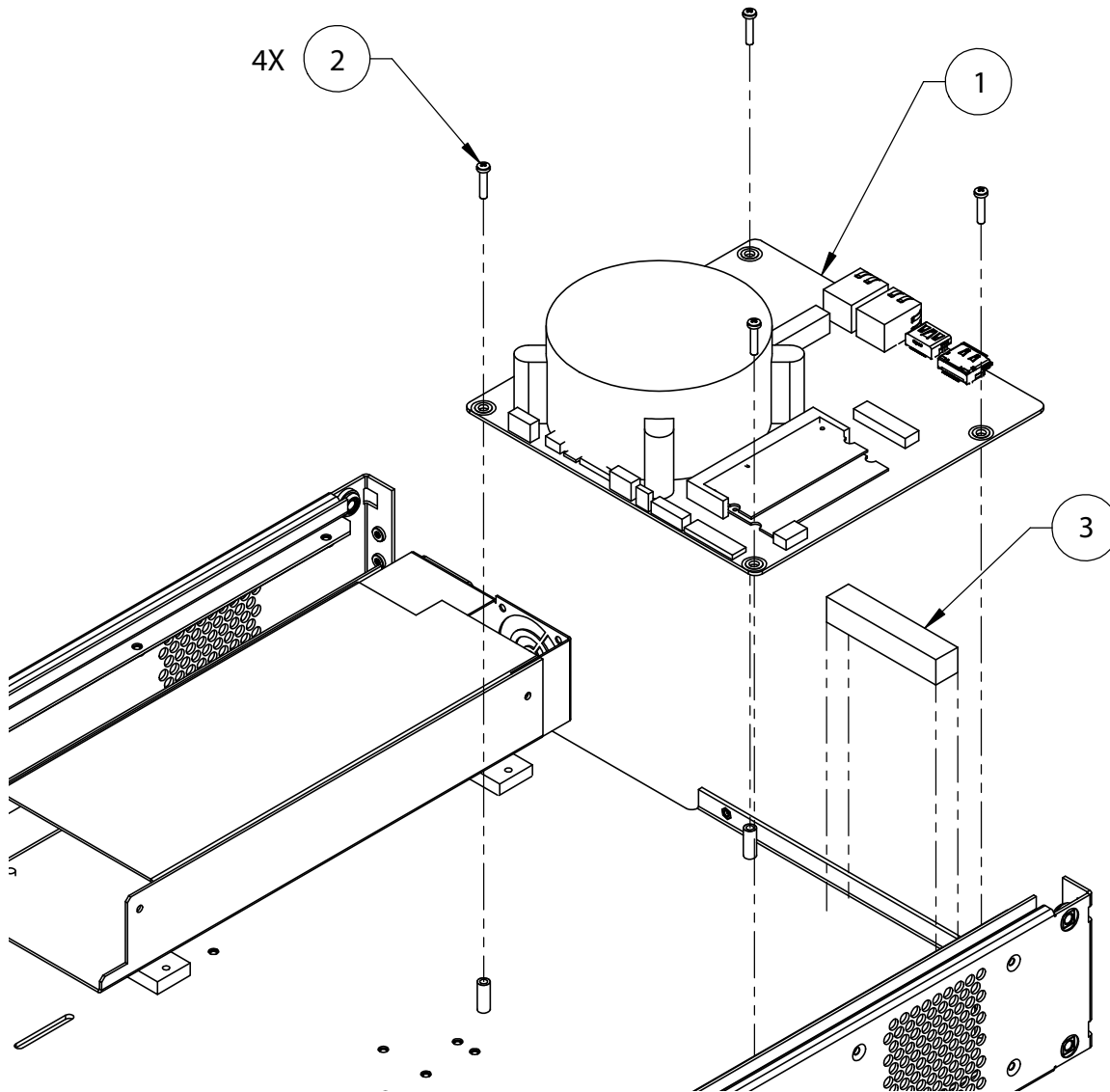


1 – Solid State Drive Power Cable

2 – CPU Assembly Power Supply Cable

3 – Cables

Figure 5-6. CPU Assembly Cable Connections



- 1 – CPU Assembly
- 2 – Mounting Screws
- 3 – Silicone block

Figure 5-7. CPU Assembly

Replacement Procedure

1. Remove the top cover as described in the [“Common Disassembly Procedure” on page 5-3](#).
2. Remove the Stiffener Plate.
3. Remove the Full Mini PCIe PCB assembly to the CPU motherboard as described in [“Replacement Procedure” in Section 5-6 “Full Mini PCIe PCB Assembly” on page 5-8](#).
4. Unplug all the cable harnesses connected to the CPU assembly.
5. Remove the four Phillips screws that secure the CPU assembly to the chassis.
6. Remove the CPU assembly.
7. Install the replacement CPU assembly.
8. Secure the CPU assembly with screws that were removed in Step 5.
9. Re-connect all the cable harnesses.
10. Install the Full Mini PCIe PCB assembly.
11. Re-connect the cable to the Full Mini PCIe PCB assembly.
12. Install the stiffener plate.
13. Install the top cover.

5-8 Solid State Drive

Use this procedure to replace the solid static drive.

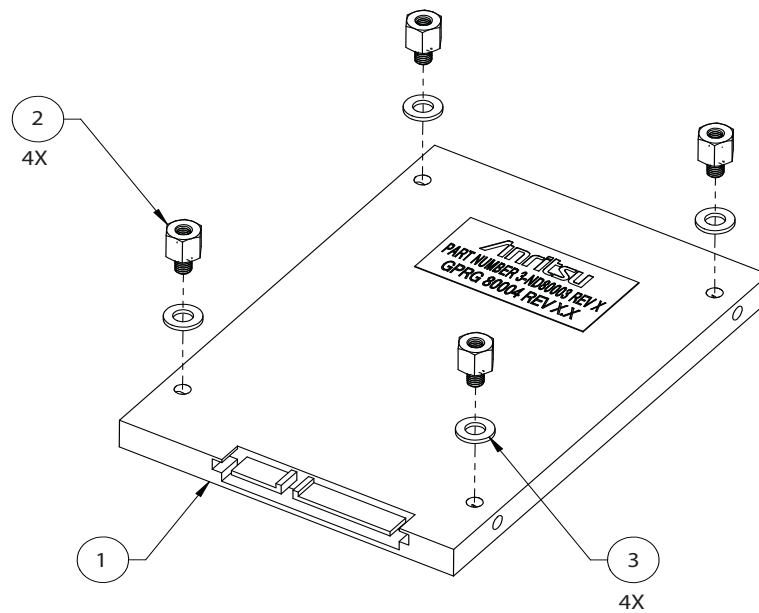
There are two versions of the replacement solid state drives due to different mounting schemes are being used in Revision 1 instrument and Revision 2 instrument.

Replacement Parts

- Revision 1 Instrument Solid State Drive – ND80984
- Revision 2 Instrument Solid State Drive – ND80997

Reference Figure

Figure 5-8 below shows how to prepare the solid state drive for Revision 1 instrument.



1 – Solid State Drive

2 – Washers

3 – Standoffs

Figure 5-8. Revision 1 MS46522A Solid State Drive

Replacement Procedure for Revision 1 Instrument

1. Remove the top cover as described in the [“Common Disassembly Procedure” on page 5-3](#).
2. Remove the stiffener plate.
3. Unplug the SATA cable and power cable from the solid state drive.
4. Flip over the instrument with the bottom cover facing upward.
5. Remove the bottom cover.
6. Place the instrument on its left side.
7. Remove the four screws that secure the solid static drive to the chassis. While removing the last screw, use one hand to hold the solid state drive so it will not drop unexpectedly.
8. Remove the standoffs and washers and install them to the replacement solid state drive.
9. Secure the replacement solid state drive to the chassis with the screws that were removed in Step 7.
10. Install the bottom cover.
11. Place the instrument on its bottom side.
12. Re-connect the SATA cable and power cable to the solid state drive.
13. Install the stiffener plate.
14. Install the top cover.

Replacement Procedure for Revision 2 Instrument

1. Use a flat head screwdriver to loosen the two captive screws that secure the solid state drive to the rear panel of the instrument.
2. Pulling gently, remove the solid state drive from the chassis.
3. Insert the replacement solid state drive through the drive slot on the rear panel.
4. Press the solid state drive into its mating socket on the IO Handler PCB assembly and gradually tighten the two flat head captive screws with a flat head screwdriver.

5-9 Back Plane PCB Assembly

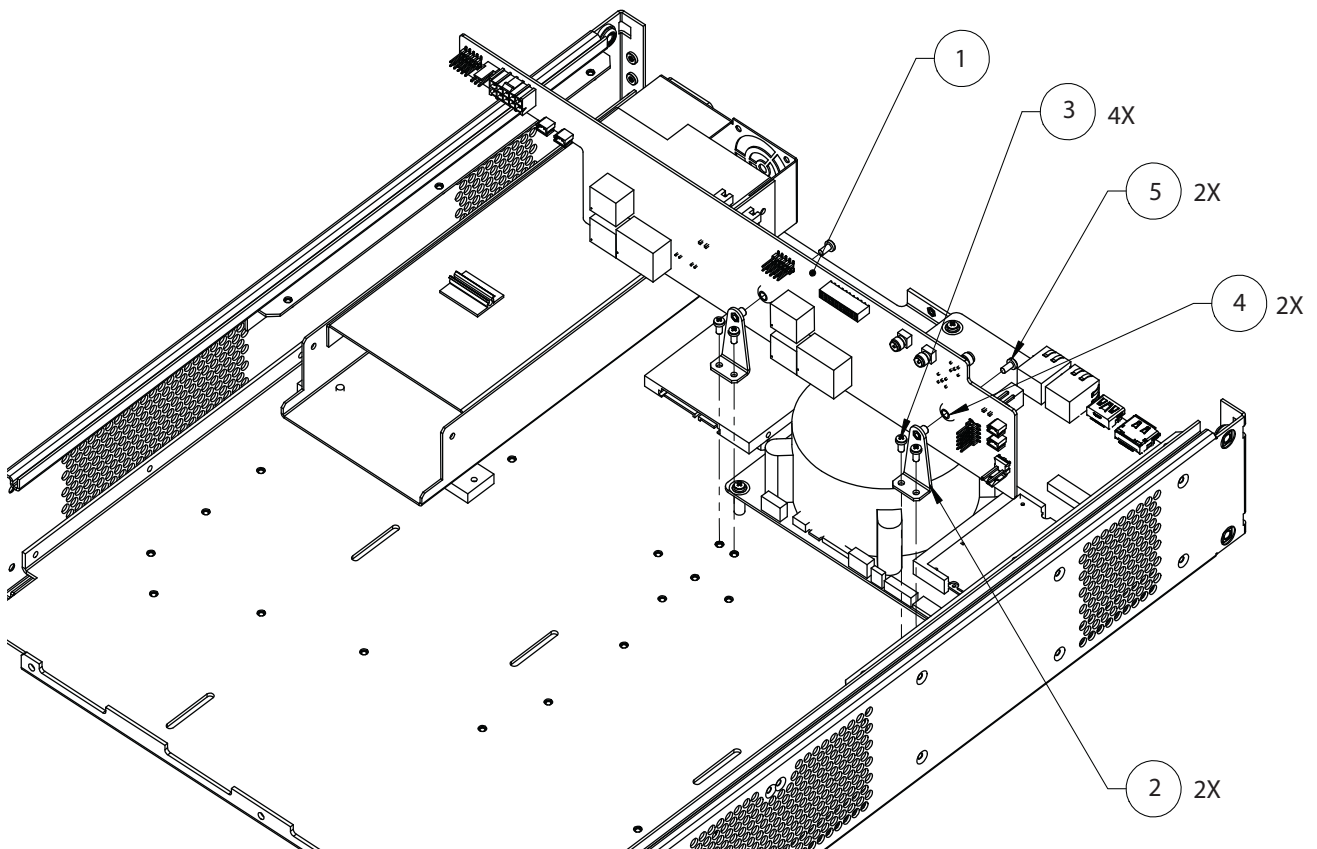
Use this procedure to replace the back plane PCB assembly.

Replacement Part

- Back Plane PCB Assembly – ND80994

Reference Figure

Figure 5-9 below shows the location of the back plane PCB assembly.



- 1 – Back Plane PCB Assembly
- 2 – Mounting Bracket
- 3 – Bracket Mounting Screw
- 4 – Isolator
- 5 – PCB Mounting Screw

Figure 5-9. Back Plane PCB Assembly

Replacement Procedure

1. Remove the top cover as described in the [“Common Disassembly Procedure” on page 5-3](#).
2. Remove the stiffener plate.
3. Remove the VNA module assembly. Refer to [Section 5-5 “VNA Module Assembly” on page 5-5](#).
4. Disconnect the rear panel 10 MHz In cable from J11 of the back plane PCB assembly.
5. Disconnect the rear panel 10 MHz Out cable from J6.
6. Disconnect the rear panel Trigger Out cable from J9.
7. Disconnect the PC ON/OFF/RST ribbon cable from J2.
8. Disconnect the PC USB interface ribbon cable from J12.
9. Disconnect the IO Handler PCB cable from J7 (for units with Option 5 only).
10. Disconnect the cable harness from J1.
11. Disconnect the PC 19 V cable harness from the P4.
12. Disconnect the rear panel fan power supply harness from J13.
13. Disconnect the IO Handler PCB cable from P15 (for units with Option 5 only).
14. Disconnect the front panel LED interface ribbon cables from J3 and J13.
15. Disconnect the power supply harness cables from J4 and P16.
16. Disconnect the left fan assembly power supply harnesses from P9 and P10.
17. Disconnect the right fan assembly power supply harnesses from P13 and P14.
18. Remove the four Phillips screws that secure the back plane PCB assembly mounting brackets to the chassis. See [Figure 5-9 on page 5-15](#).
19. Remove the PCB mounting screws and separate the mounting brackets from the PCB assembly. Be sure not to lose the two isolators.
20. Install the mounting brackets and isolators onto the replacement back plane PCB assembly. Do not tighten the PCB mounting screws.
21. Install the back plane PCB assembly to the chassis and secure it with the screws that were removed in Step 16.
22. Tighten the PCB mounting screws.
23. Re-connect all the cables.
24. Install the VNA module assembly.
25. Install the stiffener plate.
26. Install the top cover.

5-10 IO Handler PCB Assembly and USB to Digital IO PCB Assembly

Use this procedure to replace the IO Handler PCB assembly and USB to Digital IO PCB assembly.

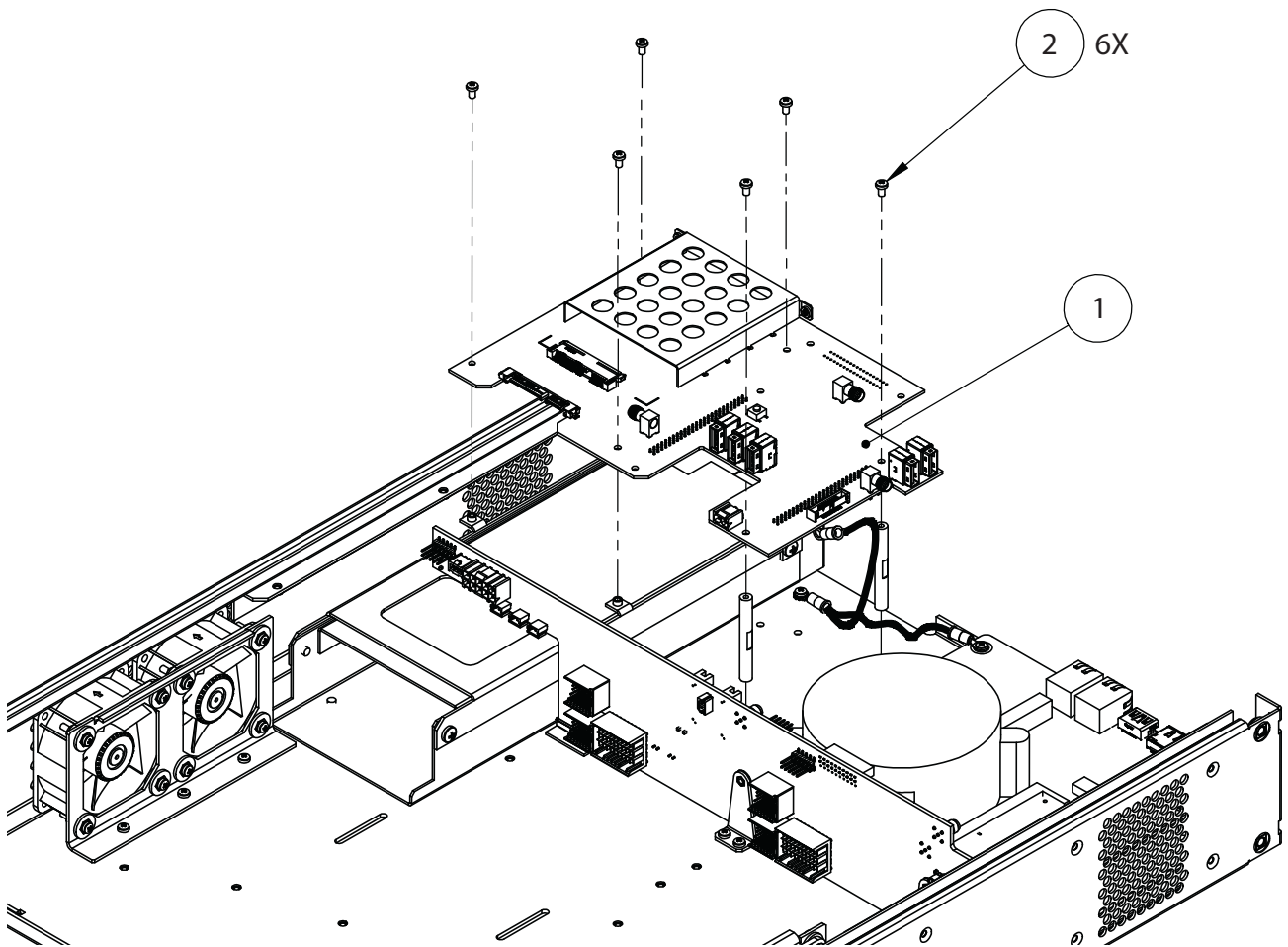
The IO Handler PCB assembly is being used in Revision 2 instrument only. The USB to Digital IO PCB assembly is being used in instruments with Option 5 only.

Replacement Parts

- IO Handler PCB Assembly – ND80995
- IO Handler PCB Assembly, Option 5 – ND80996
- USB to Digital IO PCB Assembly, Option 5 – 3-2000-1802

Reference Figures

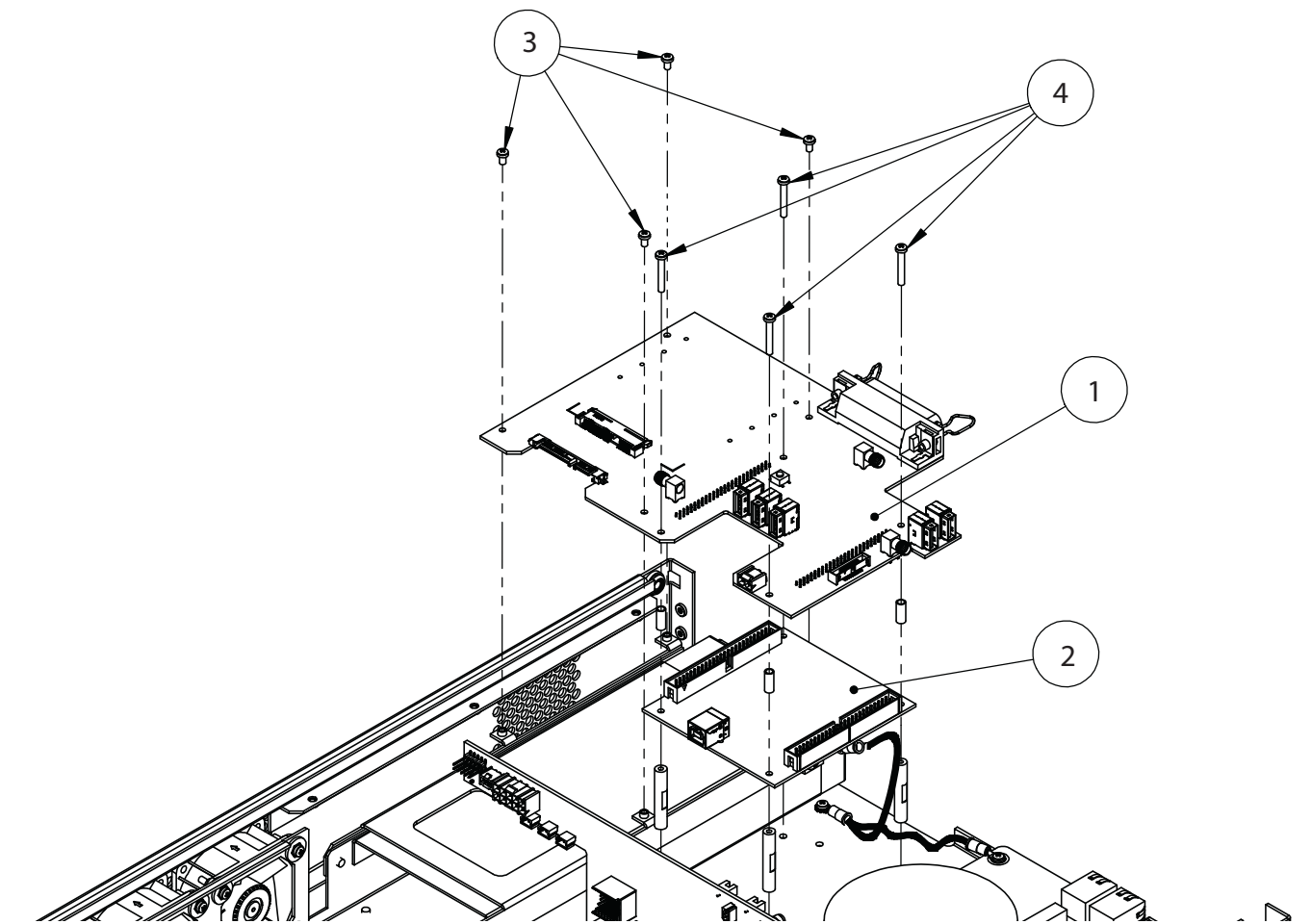
- [Figure 5-10](#) below shows the location of the IO Handler PCB assembly.
- [Figure 5-11 on page 5-18](#) shows the location of the IO Handler PCB assembly and USB to Digital IO PCB assembly.



1 – IO Handler PCB Assembly

2 –Mounting Screw

Figure 5-10. IO Handler PCB Assembly



1 – IO Handler PCB Assembly, Option 5

2 – USB to Digital IO PCB Assembly, Option 5

3 – Short Mounting Screw

4 – Long Mounting Screw

Figure 5-11. IO Handler PCB Assembly and USB to Digital IO PCB Assembly

Replacement Procedure for IO Handler PCB Assembly (Unit without Option 5)

1. Remove the top cover as described in the [“Common Disassembly Procedure”](#) on page 5-3.
2. Remove the stiffener plate.
3. Remove the solid state drive.
4. Unplug the SATA cable and solid state drive power cable from the IO Handler PCB assembly.
5. Remove the six Phillips screws that secure the IO Handler PCB assembly to the chassis and then remove it from the chassis.
6. Install the replacement IO Handler PCB assembly and secure it with screws that were removed in Step 5.
7. Re-connect the SATA cable and solid state drive power cable.
8. Install the solid state drive.
9. Install the stiffener plate and then the top cover.

Replacement Procedure for IO Handler PCB Assembly and USB to Digital IO PCB Assembly (Unit with Option 5)

1. Remove the top cover as described in the [“Common Disassembly Procedure”](#) on page 5-3.
2. Remove the stiffener plate.
3. Remove the solid state drive.
4. Disconnect the SATA cable and solid state drive power cable from the IO Handler PCB assembly.
5. Disconnect the ribbon cable from J8.
6. Disconnect the USB cable from J2 USB_3.
7. Remove the six Phillips screws that secure the IO Handler PCB assembly to the chassis.
8. Remove the IO Handler PCB assembly from the chassis.
9. Remove the USB cable linked between the IO Handler PCB assembly and USB to Digital IO PCB assembly.
10. Gently pull on the USB to Digital IO PCB assembly to separate it from the IO Handler PCB assembly. Be careful not to lose the four spacers.
11. Install the Digital IO PCB assembly to the replacement IO Handler PCB assembly, or install the replacement Digital IO PCB assembly to the IO Handler PCB assembly. Use the long mounting screws to temporarily hold the spacers in place.
12. Install the USB cable between P1 of IO Handler PCB assembly and the USB Type B connector of USB to Digital IO PCB assembly.
13. Install the IO Handler PCB assembly to the chassis.
14. Re-connect all the rest of the cables that were disconnected in Step 4 through Step 5.
15. Install the solid state drive.
16. Install the stiffener plate.
17. Install the top cover.

5-11 Fan Assemblies

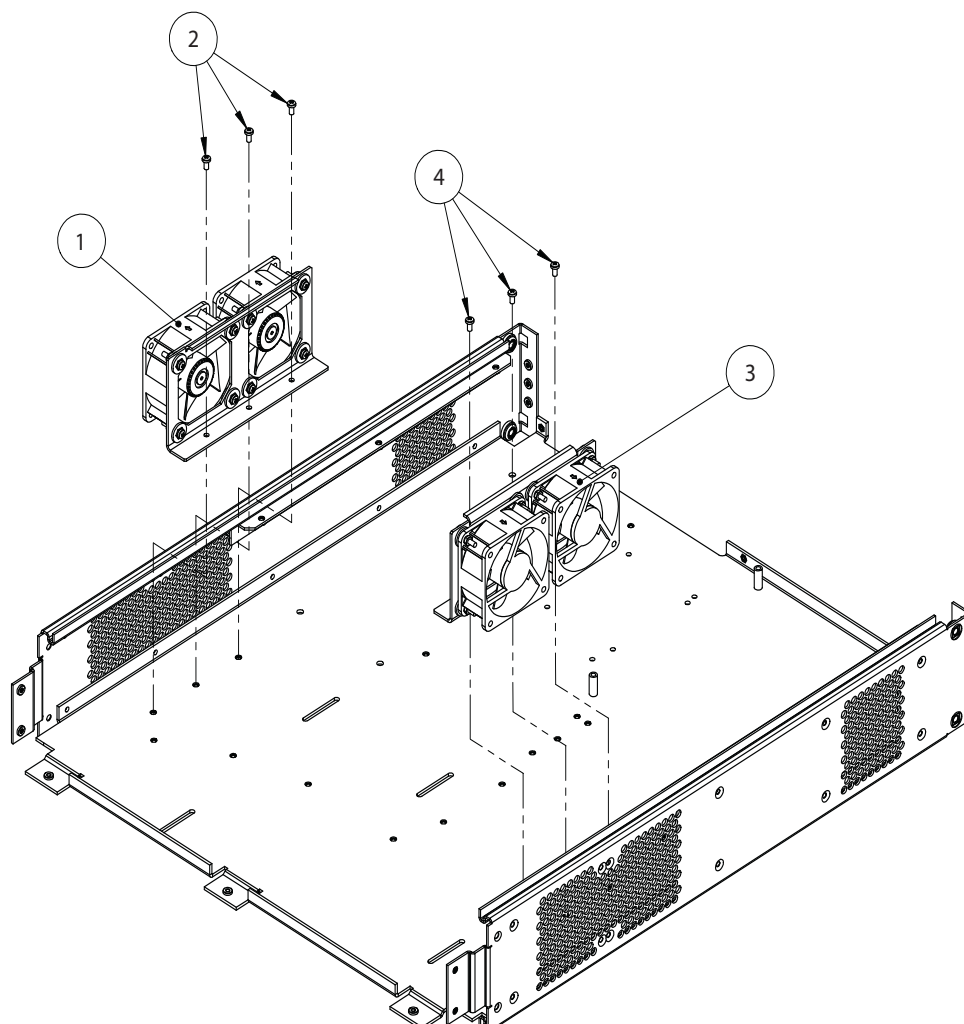
Use this procedure to replace the fan assemblies in the MS46522A.

Replacement Parts

- Fan Assembly, Right – ND80986
- Fan Assembly, Left – ND80987
- Fan Assembly, Rear – ND80989

Reference Figures

- [Figure 5-12](#) below shows the location of right and left fan assemblies.
- [Figure 5-13](#) on [page 5-21](#) shows the location of the rear fan assembly.



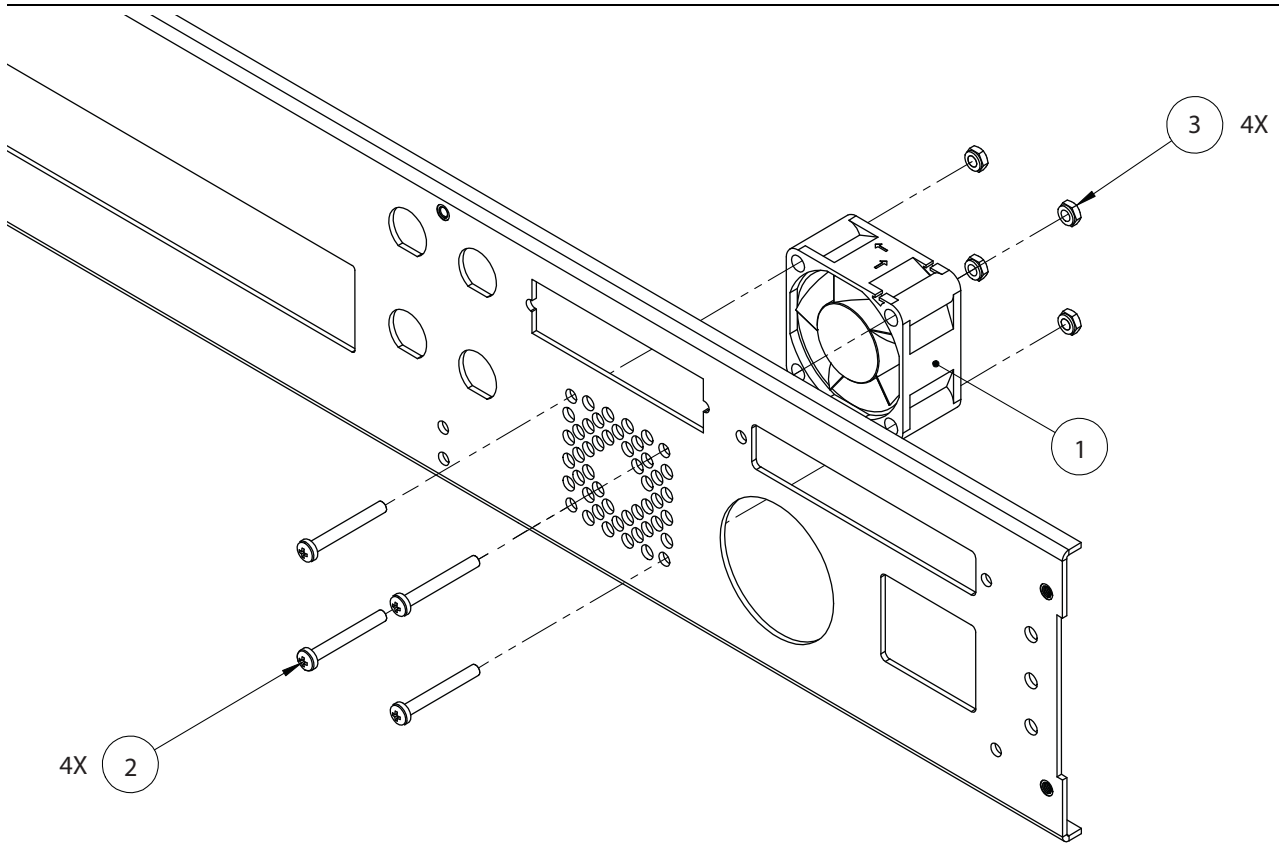
1 – Left Fan Assembly

2 – Mounting Screw

3 – Right Fan Assembly

4 – Mounting Screw

Figure 5-12. Left and Right Fan Assemblies



1 – Rear Fan Assembly

2 – Mounting Screw

3 – Hex Nut

Figure 5-13. Rear Fan Assembly

Replacement Procedure for Right Fan Assembly

1. Remove the top cover as described in the [“Common Disassembly Procedure” on page 5-3](#).
2. Remove the stiffener plate.
3. Disconnect the fan assembly power cables from P13 and P14 of the back plane PCB assembly.
4. Remove the three Phillips screws that secure the fan bracket to the chassis. See [Figure 5-12 on page 5-20](#).
5. Remove the right fan assembly.
6. Install the replacement fan assembly and secure it with the screws that were removed in Step 4.
7. Connect the fan assembly power cables to P13 and P14 of the back plane PCB assembly.
8. Install the stiffener plate.
9. Install the top cover.

Replacement Procedure for Left Fan Assembly

1. Remove the top cover as described in the [“Common Disassembly Procedure” on page 5-3](#).
2. Remove the stiffener plate.
3. Disconnect the fan assembly power cables from P9 and P10 of the back plane PCB assembly.
4. Remove the three Phillips screws that secure the fan bracket to the chassis. See [Figure 5-12 on page 5-20](#).
5. Remove the right fan assembly.
6. Install the replacement fan assembly and secure it with the screws that were removed in Step 4.
7. Connect the fan assembly power cables to P9 and P10 of the back plane PCB assembly.
8. Install the stiffener plate.
9. Install the top cover.

Replacement Procedure for Rear Fan Assembly

1. Remove the top cover as described in the [“Common Disassembly Procedure” on page 5-3](#).
2. Remove the stiffener plate.
3. For Revision 2 instruments, remove the IO Handler PCB assembly. Refer to [Section 5-10 “IO Handler PCB Assembly and USB to Digital IO PCB Assembly” on page 5-17](#) for removal procedure.
4. Disconnect the fan assembly power cable from P12 of the back plane PCB assembly.
5. Remove the mounting screws and hex nuts that secure the fan assembly to the rear panel. See [Figure 5-13 on page 5-21](#)
6. Remove the fan assembly.
7. Install the replacement fan assembly to the rear panel. Note that the direction of the air flow is inward.
8. Secure the fan assembly with the screws and nuts that were removed from Step 4. Be sure to install the ground wire lug between the fan assembly and nut at the upper right corner of the fan assembly.
9. Connect the fan power cable to P12 of the back plane PCB assembly.
10. For Revision 2 instruments, install the IO Handler PCB assembly.
11. Install the stiffener plate.
12. Install the top cover.

5-12 Power Supply Assembly

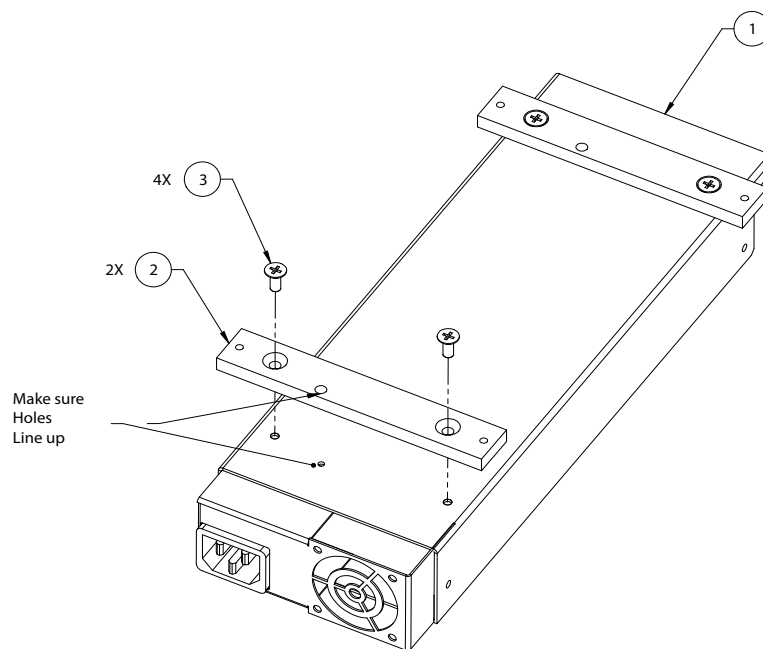
Use this procedure to replace the power supply assembly.

Replacement Part

- Power Supply Assembly – 3-40-191

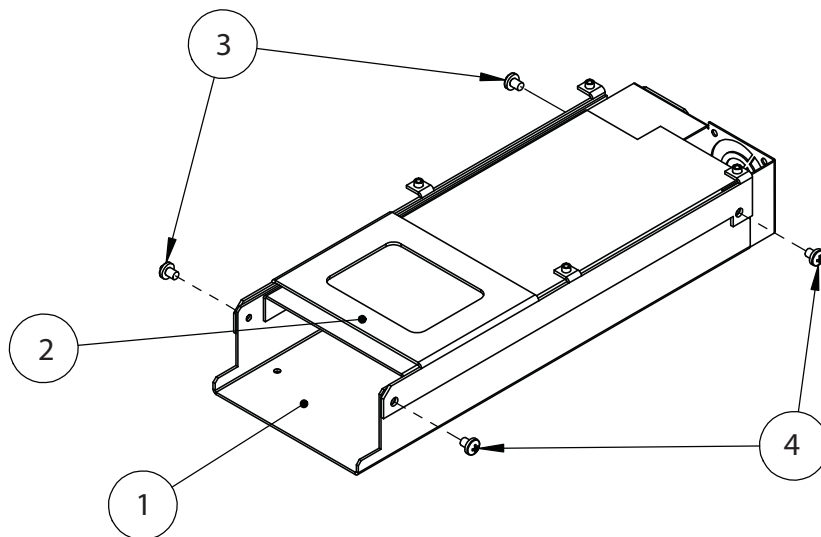
Reference Figures

- [Figure 5-14](#) below shows how the power supply mounting bars are installed to the power supply.
- [Figure 5-15 on page 5-24](#) shows a power supply with an IO Handler PCB mounting bracket installed on a Revision 2 instrument.
- [Figure 5-16 on page 5-25](#) shows the power supply cable connections.



- 1 – Power Supply
- 2 – Mounting Bar
- 3 – Mounting screw

Figure 5-14. Power Supply with Mounting Bars installed (Revision 1 instrument)

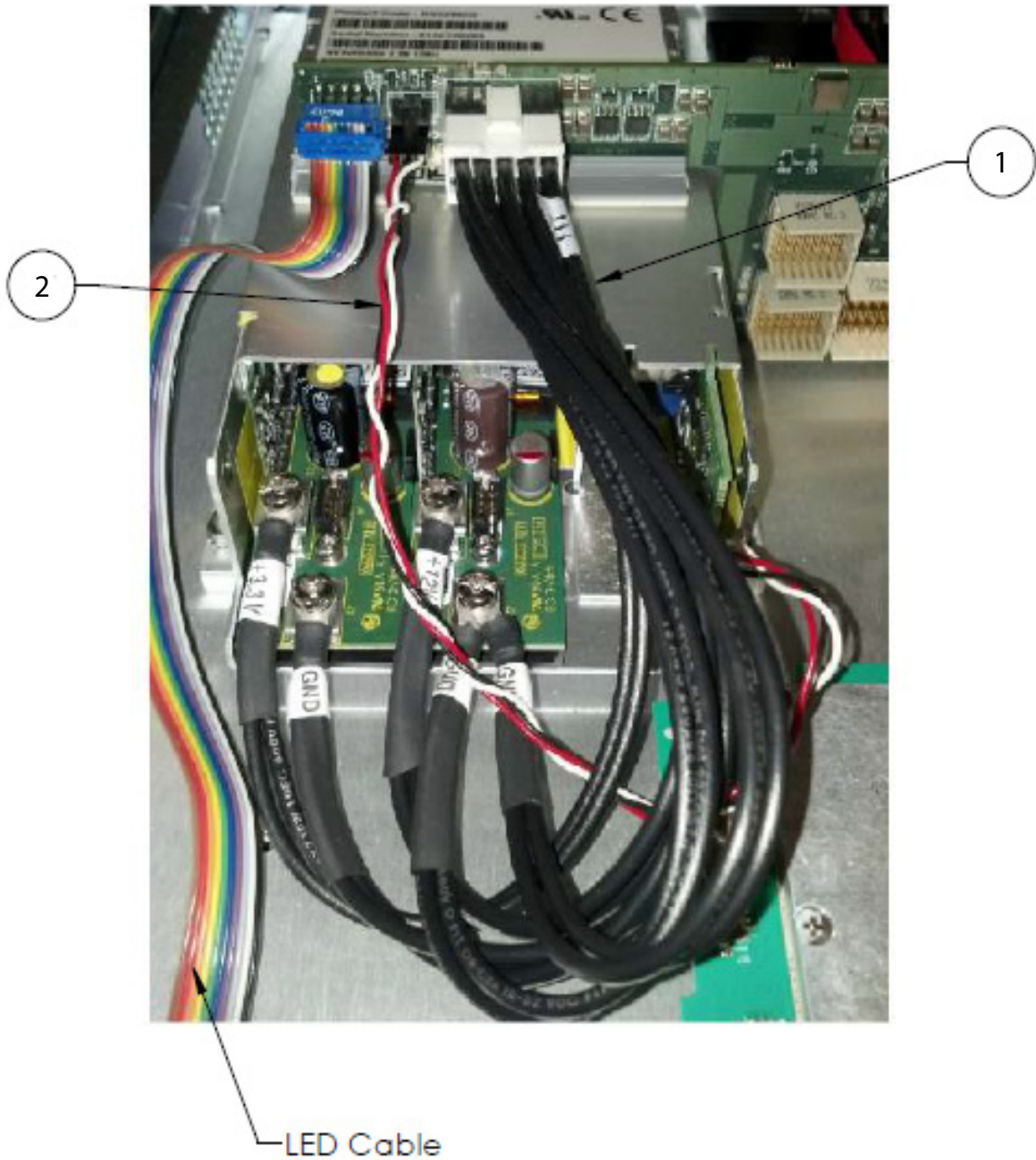


1 – Power Supply

2 – IO Handler PCB Mounting Plate

3 – Mounting screw

Figure 5-15. Power Supply with IO Handler PCB Mounting Plate installed, Revision 2 Instrument



1 – 12 V Power Supply Cable Harness

2 – 5 V Power Supply Cable Harness

Figure 5-16. Power Supply Cable Harness Connection

Replacement Procedure

1. Remove the top cover as described in the “Common Disassembly Procedure” on page 5-3.
2. Remove the stiffener plate.
3. For Revision 2 instruments, do the following:
 - a. Remove the solid state drive. Refer to [Section 5-8 “Solid State Drive” on page 5-13](#) for removal procedure.
 - b. Remove the IO Handler PCB assembly. Refer to [Section 5-10 “IO Handler PCB Assembly and USB to Digital IO PCB Assembly” on page 5-17](#) for the removal procedure.
4. Remove the VNA module assembly. Refer to [Section 5-5 “VNA Module Assembly” on page 5-5](#) for removal procedure.
5. Remove the back plane PCB assembly. Refer to [Section 5-9 “Back Plane PCB Assembly” on page 5-15](#) for removal procedure.
6. Use a Phillips screwdriver to loosen the terminal screws and then remove the 3.3 V/12 V power cable harness and disconnect the 5 V power cable harness from the power supply. Refer to [Figure 5-16 on page 5-25](#).
7. Flip over the instrument so the bottom cover is facing upward.
8. Remove the bottom cover.
9. Place the instrument on its left side.
10. Remove the five Phillips screws that secure the power supply to the chassis. Use one hand to hold the power supply in place to prevent it to drop unexpectedly.
11. Remove the power supply from the chassis.
12. For Revision 2 instruments, remove the IO Handler PCB mounting bracket from the power supply. Refer to [Figure 5-15 on page 5-24](#).
13. For Revision 1 instruments, remove the two mounting bars from the power supply. Refer to [Figure 5-14 on page 5-23](#).
14. For Revision 1 instruments, install the two mounting bars to the replacement power supply.
15. For Revision 2 instruments, install the IO Handler PCB mounting bracket.
16. Install the two power supply cable harnesses that were removed in Step 6.
17. Install the power supply to the chassis. Be sure to re-attached the Ground wire lug with a hex nut to the corner near the rear fan assembly.
18. Place the instrument on the working surface with the bottom of the instrument facing up.
19. Install the bottom cover.
20. Flip over the instrument so the top side is now facing upward.
21. Install the back plane PCB assembly.
22. For Revision 2 Instruments, install the IO Handler PCB assembly and then the solid state drive.
23. Power on the instrument, use a digital volt meter to measure the unloaded +3.3 V and +12 V output voltages. Using a tuning screwdriver, adjust the voltages to +3.7 V and +12.5 V, respectively.
24. Power off the instrument and unplug the AC power cord.
25. Re-connect the 3.3 V/12 V cable to the power supply.
26. Install the stiffener plate.
27. Install the top cover.

5-13 Test Port Adapter

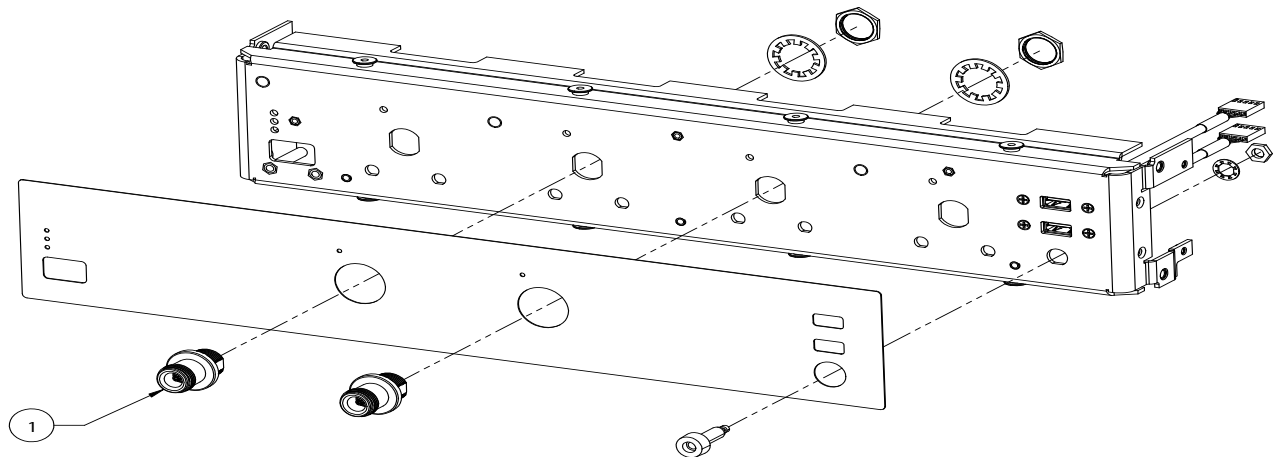
Use this procedure to replace the front panel test port adapters.

Replacement Part

- Test Port Adapter – 3-513-122

Reference Figure

- [Figure 5-17](#) below shows how the test port adapters are mounted to the front panel.



1 – Test Port Adapter (Washer and Hex Nut are included in replacement package)

Figure 5-17. Test Port Adapter

Replacement Procedure

1. Remove the top cover as described in the [“Common Disassembly Procedure”](#) on page 5-3.
2. Disconnect the flexible coaxial cable from the SMA(f) connector of the test port adapter.
3. Use a ratchet wrench with a 1/4 inch deep socket to remove the hex nut that secures the test port adapter to the front panel.
4. Remove the test port adapter from the front panel.
5. Install the replacement test port adapter to the front panel. Install the washer and then the hex nut. Tighten the hex nut with fingers.
6. Use a ratchet wrench with the 1/4 inch deep socket to tighten the hex nut. Torque to 15 ft-lb (~20.33 N-m).
7. Re-connect the flexible coaxial cable to the SMA(f) connector of the test port adapter.
8. Install the top cover.

Appendix A — Test Records

A-1 Introduction

This appendix provides test record that can be used to record the performance of the ShockLine MS46522A.

Make a copy of the following test record pages and document the measured values each time performance verification is performed. Continuing to document this process on each performance verification session provides a detailed history of the instrument's performance.

The following test record form is available:

- [“ShockLine MS46522A Test Record” on page A-2](#)

Instrument Information

Serial Number:	Firmware Revision:	Operator:
Options:		Date:

A-2 ShockLine MS46522A Test Record

System Performance Verification

____ Attached Verification Report

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